"A PROFILE OF YOUNG HYPERTENSIVE PATIENTS AT A TERTIARY CARE HOSPITAL IN SOUTH INDIA"

A Dissertation submitted in partial fulfilment of

M.D (General Medicine) branch I Examination of the Tamil Nadu

DR. M.G.R. UNIVERSITY, CHENNAI

to be held in 2016.

DECLARATION

I, Dr Krupa George hereby declare that the dissertation entitled "A PROFILE OF YOUNG HYPERTENSIVE PATIENTS AT A TERTIARY CARE HOSPITAL IN SOUTH INDIA" is a bonafide original work done by me, towards the M.D. Branch-I (General Medicine) Degree Examination of the Tamil Nadu Dr. M.G.R. University, Chennai to be conducted in 2016.

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CERTIFICATE

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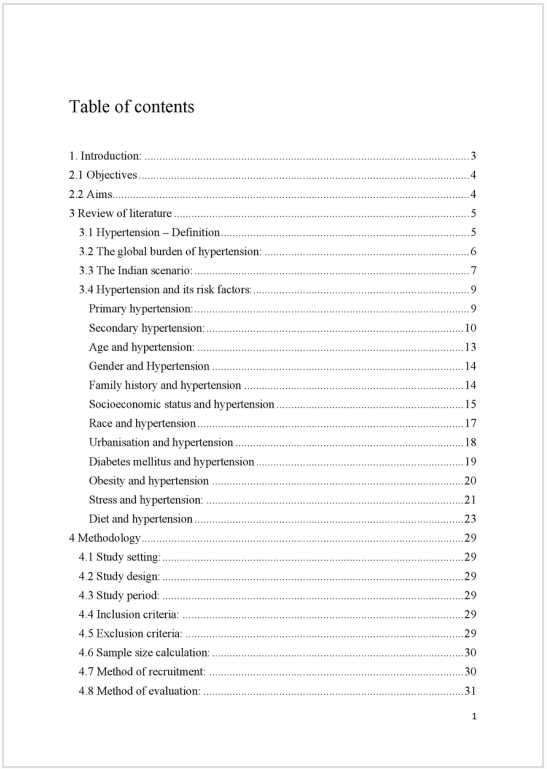

Table of contents

1

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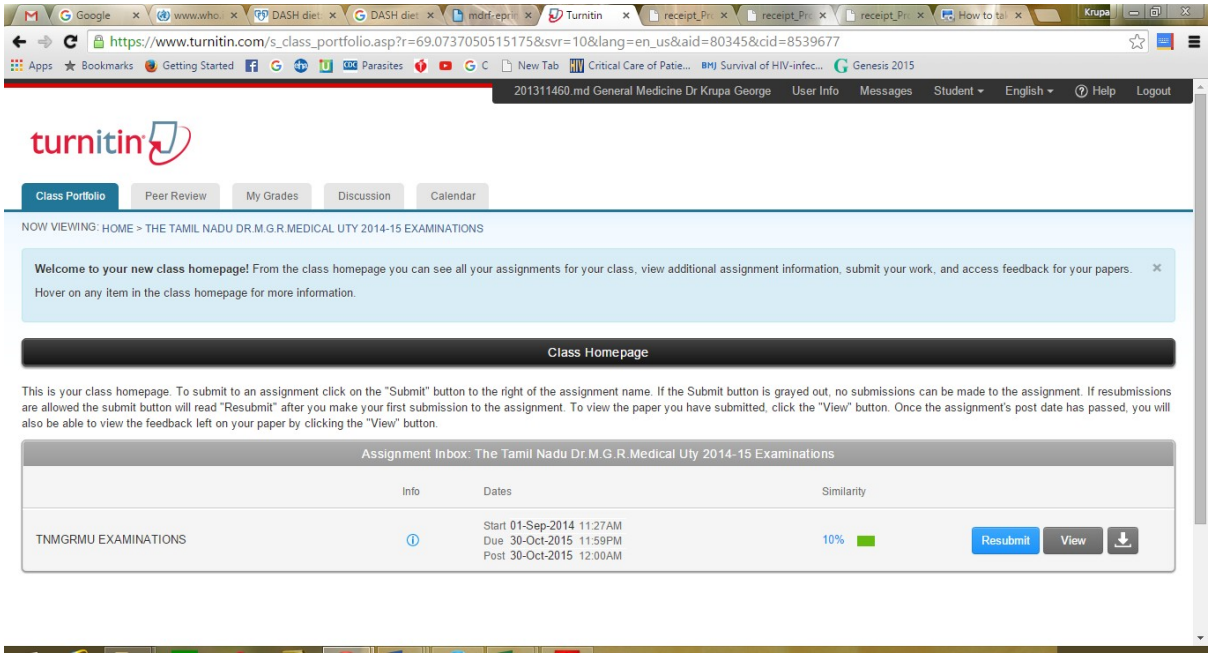
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ACKNOWLEDGMENTS

I would like to sincerely thank my Guide Dr.Samuel George Hansdak, for his input and guidance through my study and dissertation completion. I would also like to thank Dr.Anand Zachariah, for taking the time to discuss and guide me with my dissertation.

I would like to specially thank Dr Sowmya S. for giving me the idea for this study and the constant encouragement through it.

I would also like to specially thank my family, for their constant support and prayers.

I would also like to thank my friends, Dr.Sheena E. and Dr. Ajoy O.for their inputs into the dissertation.

I would also like to thank Ms. Mahendri, head of the Dietary department and the dieticians for all their help with the dietary evaluation.

I would also like to thank Mr. Andrew Babu, Head of the Physiotherapy department for his support and Ms.Winrose for helping with the physical activity assessment.

I would like to thank the Department of Internal Medicine for all the support and guidance I received in preparing this document.

I would like to specially mention all the patients and their families who agreed to be a part of this study despite being in times of great personal distress.

I would like to close by saying thanks to God, who has given me strength.

Table of contents

1. Introduction:

Systemic arterial hypertension, or simply called hypertension, is a major medical and public health problem worldwide as it is an important risk factor for coronary heart disease, heart failure, cerebrovascular disease and renal failure. The past century has seen hypertension grow to epidemic proportions across the world.

What is worrying, is that hypertension is usually asymptomatic resulting in some calling it the "the silent killer". Patients may be asymptomatic not only to hypertension, but also to the organ damage caused by it. Cardiovascular disease risk increases as the blood pressure increases starting at a blood pressure of 115/75 mm Hg.

Traditionally, hypertension is a disease that has been associated with older age groups. Over time, the profile of hypertension has changed. Population studies have shown an increasing prevalence across populations. The prevalence among younger individuals in also increasing,

This study aims to study the profile of younger patients (18 – 40) years with hypertension, as they comprise a population of "young hypertensive" patients. Though there is no set definition of "young hypertension", individuals younger than 40 years of age have traditionally been considered to have young onset hypertension and evaluated for secondary causes of hypertension.

By studying this younger age group of hypertensive patients, the study aims to determine the prevalence of secondary hypertension and describe the risk factors of primary hypertension in this population.

2.1 Objectives

To study and profile patients with young onset hypertension who present to the General Medicine department of CMC, Vellore during a period of 1 year.

2.2 Aims

1. To determine the prevalence of secondary hypertension among young hypertensives presenting to the Department of General Medicine.

2. To identify the modifiable risk factors for Essential hypertension in young hypertensive patients.

3 Review of literature

3.1 Hypertension – Definition

The Joint National Committee VII defined hypertension in adults aged 18 and older as follows. The blood pressure reading is taken as an average of two or more properly measured readings taken with the patient seated on each of two or more office visits.

Blood pressure classification	**Systolic BP (mm Hg)**	**Diastolic BP (mm Hg)**
Normal	< 120	<80
Prehypertension	121 – 139	80 – 89
Stage I hypertension	140 – 159	90 – 99
Stage II hypertension	≥ 160	≥ 100

3.2 The global burden of hypertension:

Times change and with it the spectrum of diseases affecting the human race. Non communicable diseases have overtaken communicable diseases as the leading cause of death worldwide. With Industrialisation and Globalisation, the burden of non-communicable diseases has extended to the developing world.

Non communicable diseases account for approximately 60% of death worldwide with cardiovascular diseases accounting for 30%. In 2008, it was estimated that 4 out of 5 deaths in countries of low- and middle- income, were due to non- communicable diseases. The effect of these diseases is felt across ages with 1 in 4 deaths due to non-communicable diseases occurring in those below the age of 60 (1)

Across the world, cardiovascular diseases account for close to 17 million deaths a year, which is nearly a third of all deaths. Of these, complications secondary to hypertension accounts for 9.4 million deaths worldwide. Hypertension is responsible for 45% of deaths due to ischemic heart disease and 51% of deaths due to stroke (2)

The burden of DALYs (Disability Adjusted Life Years) due to non-communicable diseases is 48% worldwide. In 2010, the global cost of cardiovascular disease was estimated at US 836 billion (the average per capita cost being US$ 125) with an estimate that by 2030, this would rise to US$1,044 billion. Thus this estimate predicts a 22% increase in the financial burden of cardiovascular disease.(1)

3.3 The Indian scenario:

Hypertension is a leading cause of Morbidity and mortality in India. A study done in 1997, looking at the global burden of disease, reported that in 1990 in India, there were a total of 9.4 million deaths, with cardiovascular diseases accounting for 2.3 million. Deaths due to coronary heart disease were 1.2 million and another 0.5 million deaths were due to stroke (3).

Based on this data and the trends of these diseases, it was predicted that by 2020, there would be an increase in cardiovascular deaths in India by 111%. This increase is far greater than that predicted for countries like China (77%), other Asian countries (106%) and the economically developed countries (15%) (4).

57% of all stroke deaths and 24% of all coronary heart disease deaths in India are secondary to hypertension. Hypertension is a controllable disease and so its management is of utmost importance if the mortality due to it is to be reduced.

Epidemiological studies looking at the prevalence of hypertension in India, have shown a high prevalence in various parts of the country with rates almost similar to that of a developed country like the United States of America.

Studies done in the 1950s, looking at urban populations in India, had taken a systolic blood pressure cut off of 160 mm Hg and a diastolic blood pressure cut off of 95 mm Hg and had reported the prevalence of hypertension to be 1.2 – 4.0%.

From 1960 to 2000, there were many studies done which looked at the prevalence of hypertension in various parts of India and the reported prevalence were – 4.35% in

Agra, 6.43% in Rohtak, 15.52% in Bombay, 14.08% in Ludhiana, 10.99% in Jaipur, 11.59% in Delhi and 13.1% in Chandigarh (4).

Subsequent studies have shown a much higher prevalence of hypertension with the prevalence in Jaipur reported at 30% in men and 33% in women, in Mumbai at 44% in men and 45% in women (4) and in Trivandrum at 31% in men and 41% in women (5) and in Chennai at 14% (6).

Yadav et al, have reported the age and sex matched prevalence of hypertension in an urban population of Lucknow to be 32.2%. They also found the prevalence of prehypertension in this same population to be 32.3%. While the prevalence of hypertension was highest in the age group of 60 – 69, the prevalence of prehypertension was highest in the age group of 30-39.

A higher proportion of hypertensives (66%) and pre-hypertensives (56%) had two or more cardiovascular risk factors as compared to normotensive subjects (39%) (7)

Das et al, studied the prevalence of hypertension in an urban population in West Bengal, and found it to be 24.9%. They also noted that 58.7% of the study subjects had prehypertension (8).

Studies looking at the prevalence of hypertension in rural populations have recorded alarmingly high rates of hypertension prevalence.

In a study from rural Davangiri, Karnataka, the prevalence of hypertension was found to be 19.1% in men and 17.5% in women (9). In a population in rural Haryana, the prevalence of hypertension, in a population whose ages ranged between 16 to 70, was reported at 3.5% in men and 5.8% in women (10).

3.4 Hypertension and its risk factors:

Hypertension, can be broadly divided into two groups – the first being Primary hypertension or Essential hypertension and the second being Secondary hypertension.

The difference between the two is that in Secondary hypertension, the hypertension is due to an underlying disease (example: chronic kidney disease or Pheochromocytoma) while in Essential hypertension, there is no underlying cause.

Essential hypertension occurs due to the interaction between genetic and environmental factors.

i) Primary **hypertension**:

Different prevalence rates in different populations can be attributed to the different environmental factors like smoking, alcohol use, excess dietary sodium and fat, low potassium and fibre intake, physical inactivity and psychosocial stress. These environmental factors are modifiable and it is important to understand them as part of the management of hypertension involves addressing the modifiable risk factors.

The non-modifiable risk factors are age, gender, ethnic background and socioeconomic status. Epidemiological evidence has shown that in India, changing population demographics has resulted in increased risk factors for hypertension. Contributing to these factors are Urbanisation and development, increasing life expectancy and affluence. Changing dietary practices, increasing sedentary lifestyles and increasing stress have all contributed to the epidemic of hypertension.

The following is an elaboration on the various risk factors of hypertension.

ii) Secondary hypertension:

There are a number of common and uncommon diseases that cause a rise in blood pressure and may result in secondary hypertension. The underlying cause is in many instances is potentially correctable. These may be present with the risk factors for Primary hypertension, making the control of blood pressure difficult. Patients who should be suspected to have a secondary cause for the hypertension are those who have resistant hypertension or who develop hypertension at extremes of age.

A secondary cause should also rule out in those presenting with symptoms of a secondary cause or with abnormal laboratory tests (example: hypokalaemia in primary aldosteronism, or elevated creatinine in chronic kidney disease).

The following are some of the causes of secondary hypertension:

Renal	Parenchymal diseases Renal tumors Obstructive uropathy
Renovascular	Arteriosclerotic Fibromuscular dysplasia
Adrenal	Primay aldosteronism Cushing's syndrome 17 α hydroxylase deficiency 11 β hydroxylase deficiency 11-hydroxysteroid dehydrogenase deficiency Pheochromocytoma
Aortic coarctation	

Obstructive sleep apnoea	
Preeclampsia/eclampsia	
Neurogenic	Psychogenic Diencephalic syndrome Familial dysautonomia Polyneuritis (acute porphyria, lead poisoning) Acute increased intracranial pressure Acute spinal cord section
Miscellaneous endocrine	Hypothyroidism Hyperthyroidism Hypercalcemia Acromegaly
Medications	High-dose estrogens Adrenal steroids Decongestants Appetite suppressants Cyclosporine Tricyclic antidepressants Monoamine oxidase inhibitors Erythropoietin Nonsteroidal anti-inflammatory agents Cocaine

The etiological cause for the secondary hypertension varies with age groups. In children, an identifiable secondary cause is present in up to 85%, with the commonest being renal dysfunction. In middle aged adults, this decreased to 5-10% with the commonest cause being primary hyperaldosteronism.

A study prospective conducted in Sweden, among 7455 men aged 47 to 54 found the prevalence of secondary hypertension to be 11%. The commonest cause being renal parenchymal disease (11).

A retrospective study, also conducted in Sweden, among 1000 women, found the prevalence of secondary causes of hypertension to be 5% with the commonest cause being renal parenchymal disease, followed by endocrine causes and renovascular disease. In 23% of these patients, their blood pressure normalised following treatment of the underlying disease (12).

Studies from multi-speciality clinics and blood pressure clinics have reported a prevalence of secondary hypertension between and 8 to 10 % (13,14).

A prospective study from Japan, evaluated 1020 patients for secondary causes of hypertension. Subjects with renal parenchymal disease were excluded. A two tiered evaluation for endocrine causes was done. They found the prevalence of secondary causes to be 9.1%, with the commonest cause among this being primary aldosteronism (6%). Previous studies evaluating the causes of secondary hypertension had reported the prevalence of primary aldosteronism to be much less, mainly because specific evaluation for the same was not done (15).

iii) Age and hypertension:

Blood pressure progressively increases with increasing age, and this phenomenon though a common one, is not universal. Hypertension that is age- related is predominantly systolic. It has been noted that systolic blood pressure rises into the 8th and 9th decades while the diastolic blood pressure remains constant or declines after 50 years of age (16).

In individuals over the age of 50, the systolic blood pressure is a better predictor of risk and in those below 50, it is the diastolic blood pressure that is a better predictor of mortality (17,18).

Studies from around the world and India, have shown an increasing prevalence of hypertension with increasing age. The third NHANES study showed that the prevalence of hypertension increased with increasing age. The prevalence of hypertension was 7.3% in those aged 18 – 39, 32.4% in those aged 40 – 59, and 65.0% in those aged 60 years.

Studies from India, have shown similar results. A study in a Parsi community of Mumbai, found the prevalence of hypertension to be 56.3% in those 60 years or older and 64.2% in those 70 years or older (19). Hazarika et al recorded a prevalence of hypertension in a geriatric population of Assam to be 63.63% (20). In South India, a study from Kerala, found the prevalence of hypertension in the elderly to be 51.8% (21). Similarly, another study, reported a 65% prevalence of hypertension in an elderly population combining subjects from India and Bangladesh (22).

Epidemiological studies have been carried out in various parts of the country on younger individuals. A study on an apparently healthy Western Indian population found the prevalence of hypertension among those less than 40 years to be 11% (23). A study among from Karnataka, looking at the prevalence of hypertension in 991 individuals between the ages of 20 and 40 found it to be nearly 8% (24).

Thus, age is a non-modifiable risk factor for developing hypertension.

iv) Gender and hypertension

The relationship between gender and hypertension has been studies, with prevalence rates between the two sexes varying by world region. The absolute differences are small, with the greatest difference seen in the countries comprising Latin America and the Caribbean at 5.9% (25).

It has been seen that at younger ages, the prevalence of hypertension in men is more than that of women, and with increasing age, the prevalence in women seems to be more.

v) Family history and hypertension

Hypertension has been known to run in families. This could be attributed to shared genetic and environmental factors.

The Johns Hopkins precursor study found that subjects who had a positive parental history of hypertension had higher mean systolic and diastolic blood pressure levels in medical school.

They also found that by the age of 40, the cumulative incidence of hypertension was 4 times greater in those whose parents had hypertension than in those whose parents did not.

The risk of developing hypertension was even greater in those whose parents had an early onset of hypertension. Subjects whose mother and father had developed hypertension at the age of 55 or younger had a 7.1 fold higher risk of developing hypertension during their adult life as compared to those without a hypertensive parent (26).

vi) Socioeconomic status and hypertension

Socioeconomic status is a risk factor for cardiovascular disease. The relationship between the two is not direct but rather through a complex interplay between various factors like stress, exercise and diet. And because these factors are modifiable, it is important to understand this. Various models have been proposed to explain the relationship between socioeconomic status and hypertension.

It has been postulated that socially disadvantaged people could face stressors from their job and neighbourhood which coupled with poor knowledge and strained finances could result in these individuals consuming food that is cheap and high in calories, saturated fats and salt, which in turn would result in obesity and hypertension. These in turn could result in chronic ill health, further limiting their job options and resulting in further stress (27).

Lower socioeconomic status has been associated with higher mean blood pressures in studies from developed countries. This inverse relationship is stronger and more consistent in women than in men.

It has been seen that subjects with lower socioeconomic status have a poorer biobehavioral profile with regards to the modifiable risk factors of body mass index, heart rate, waist circumference, alcohol consumption, smoking and exercise.

The RECORD Cohort Study (Residential Environment and CORonary heart Disease) from France, studied the relationship between socioeconomic status and hypertension

among 5941 participants aged 30 – 79 years and found an inverse relationship between systolic blood pressure and decreasing individual education and decreasing residential neighbourhood education. The bulk of the associated between socioeconomic status and hypertension was mediated by body mass index/ waist circumference and resting heart rate (28).

In the USA, the National longitudinal Study of Adolescent Health, a longitudinal study with more than 15,000 young adults found that higher household income and being married were both independently associated with a lower systolic blood pressure. They also found that the association between higher household income and a lower systolic blood pressure was by way of a lower resting heart rate (29).

A study among 11,053 Israeli male military officers, found that systolic and diastolic blood pressures were highest among low ranking officers. Higher mean systolic blood pressures were also noted among office workers as compared to physical workers (30).

Studies from India have shown varied results. A study looking at the association of socioeconomic status and hypertension in a rural South Indian population, found the prevalence of hypertension to be 22.5% in those belonging to the highest socioeconomic group and 8.8% in those belonging to the lowest socioeconomic group (31).

In a study looking at rural tribal populations in India, it was noted that the prevalence of hypertension increased with increasing literacy and among land owners.

vii) Race and hypertension

Prospective studies over time have shown a difference in hypertension between races. Among the various races, the prevalence and severity of hypertension tends to be more among the blacks. Factors that could contribute to this include environmental and genetic factors. The environmental factors that have been studied include high-sodium/low-potassium diets and low socioeconomic status. Genetic factors in blacks also play an important role predisposing them to left ventricular hypertrophy and hypertensive nephrosclerosis. Polymorphisms in the apolipoprotein L1 (APOL1) genes are more common in African-Americans than Europeans. This seems to put them at increased risk of end stage renal disease secondary to hypertensive nephrosclerosis and focal segmental glomerulosclerosis.

Wang et al, in a prospective study compared ambulatory blood pressure between subjects of European-American descent and African-American descent over a period of 15 years, and found that those of African-American descent, had higher day time and night time systolic and diastolic ambulatory blood pressures. They also noted a decline in the blunting of nocturnal blood pressure among African-Americans by the age of ten which progressively worsened into adolescence (32).

Studies from India have also shown a variation in the prevalence of hypertension and other cardiovascular disease risk factors among various ethnic groups within the country (33,34).

viii) Urbanisation and hypertension

Epidemiological studies have shown the prevalence of hypertension to be higher in urban than in rural residences. The contributing factors this have been attributed to changes in the life style pattern, diet, physical activity and increased stress levels.

The ICMR-INDIAB study, which looked at the prevalence of hypertension in urban and rural populations in three states and a union territory (Tamil Nadu, Jharkhand, Chandigarh and Maharashtra) found the prevalence of hypertension to be significantly higher among urban than rural populations. A study comparing rural and urban populations in Karnataka found the prevalence of hypertension among 991 individuals between the ages of 20 and 40 to be 8.79 % in the urban population and 7.30 % in the rural population (24).

ix) Diabetes mellitus and hypertension

Diabetes mellitus and hypertension are two diseases that are seen together, especially with increasing age. Cardiovascular risk is significantly increased in diabetic individuals and in the presence of hypertension, this is increased even further. Thus, strokes, transient ischemic attacks and peripheral vascular disease are seen more frequently in diabetics with hypertension than in those without. Both diabetes and hypertension, independently cause accelerated atherosclerosis and ischemic heart

disease. 35 – 75% of the complications of diabetes mellitus have been attributed to hypertension.

The prevalence of hypertension in diabetic individuals is twice that in non-diabetic individuals. This is especially so in Type I diabetics. Before the fifth decade, the prevalence of hypertension in diabetics is more in men than in women, subsequently the prevalence of hypertension appears to be more in women. The coexistence of diabetes mellitus with hypertension is more prevalent among blacks as compared to whites. The coexistence is also higher among those belonging to a lower socioeconomic status. The determinants associated with hypertension in diabetic have been attributed to age, gender, and race, longer duration of diabetes, obesity and persistent proteinuria. In Type I diabetics, it has been noted that hypertension develops following the onset of persistent proteinuria. Patients without diabetic nephropathy usually remain normotensive. In Type II diabetics, it has been found that about a third are hypertensive at the onset of diagnosis. Hypertension in diabetes results in acceleration of diabetic nephropathy and retinopathy.

The pathology of hypertension in diabetics parallels that of hypertension that is age related and is characterised by increased vascular resistance. Premature ageing of the vascular system has been seen in diabetics with hypertension and this has been attributed to the accelerated atherosclerosis. This premature ageing probably contributes to the isolated systolic hypertension and decreased baroreceptor sensitivity that is seen more commonly in young diabetics with hypertension. The role of hyperinsulinemia and insulin resistance in linking diabetes, hypertension and dyslipidaemia has been studied. Observations that have been made include, higher

levels of triglycerides and low High density lipoproteins in associated with hyperinsulinemia and insulin resistance. Hyperinsulinemia has also been shown to interfere with fibrinolysis as evidenced by higher levels of fibrinogen and Plasminogen activator inhibitor. In tissue culture, insulin has been shown to induce sub-intimal smooth muscle and fibroblast proliferation, which could result in an acceleration of the atherosclerotic process. Thus, hyperinsulinemia that is associated with diabetes and obesity could result in an acceleration of atherosclerosis resulting in hypertension (35)

x) Obesity and hypertension

The relationship between obesity and hypertension can be seen from childhood. Even at an early age, as body weight and adiposity increase, blood pressure rises. The distribution of fat is also important, with central obesity being associated with more insulin resistance and there by resulting in hypertension.

The risk of hypertension is five times more in obese individuals in comparison to those whose weight is normal (36). The cause for the hypertension related to obesity has been attributed to higher levels of angiotensinogen that is released from adipocytes which acts to raise blood pressure, a greater blood volume that is associated with an increased body mass and an increase in blood viscosity that is caused by an increase in profibrinogen and plasminogen activator inhibitor 1 that are released by adipocytes (37).

As the Body mass index increased above 21 Kg/Mt², the risk of dyslipidaemia rises with rising Low Density Lipoprotein (LDL) levels which is an important risk factor for coronary heart disease. Low High Density Lipoprotein (HDL) with high levels of triglycerides further increases the risk of coronary heart disease.

xi) Stress and hypertension:

Stress can be defined as a pathological process within the body to external stimulus and abnormal states that affects its homeostasis. Stressors of an emotional nature result in psychological stress. The stressors of modern life are related to work, family, finances, health, and societal pressures. All of these can contribute to hypertension in the long run.

The relationship between stress and hypertension has been studied with the elaboration of various pathophysiological mechanisms.

In the acute setting, stress, results in an increased blood pressure by increasing the cardiac output and heart rate without changing the total peripheral resistance. Levels of certain hormones like catecholamines, cortisol, aldosterone, vasopressin and endorphins that may partly explain the increase in blood pressure. This heightened sympathetic response in the long term could result in vascular remodelling, resulting in hypertension. Stress could also indirectly contribute to hypertension through associated factors like over eating, obesity, alcohol use and physical inactivity.

A primary activation of the sympathetic nervous system has also been suggested. Acute stress is also known to cause a decrease in urinary sodium excretion, which also contributes to hypertension. " white-coat hypertension" is well known to occur due to stress, and in such a setting, the need for ambulatory blood pressure monitoring is needed (38).

Prospective studies looking at blood pressure reactivity and the risk of developing hypertension, have shown that individuals with higher blood pressure reactivity during stressful tasks had a greater odds of developing hypertension. The same was noted of those whose blood pressure remained high during the recovery period following completion of the stressful task.

A study among Information Technology professionals, found a high prevalence of hypertension (31%) and prehypertension(45.7%) with high work place related stress (39).

The role of relaxation techniques to decrease stress and thereby blood pressure is being acknowledged more and more

xii) Diet and hypertension

With time, changes in dietary patterns have contributed to an increase in non-communicable diseases like Hypertension, Diabetes mellitus and Dyslipidaemia. Globalisation has also resulted in a more widespread consumption of foods high in salt, sugar, refined starch and unhealthy fats.

It is well known that various dietary factors influence blood pressure. These include weight control, decreased consumption of salt, increased consumption of potassium and reduced alcohol consumption.

Salt:

Rising dietary salt has been seen to cause a rise in blood pressure. This observation has been backed by data from animal studies, epidemiological studies and meta-analyses of clinical trials. The INTERSALT study, was an epidemiological study with 10,079 subjects from 32 countries, which found a positive lineal relation between systolic blood pressure and twenty four hour sodium excretion. They also noted that a 100 mmol per day higher consumption of sodium a day was associated with a higher systolic and diastolic blood pressure of 3-6/0-3 mm Hg. This relation was noted in both sexes and also across age groups (40).

A meta-analysis of randomised trials comparing modest reductions in salt intake versus regular salt intake for a period of at least 4 weeks, found that a reduction of 6 grams of salt a day resulted in 7.11/3.88 mm Hg fall in blood pressure in hypertensive

individuals and a 3.57/1.66 mm Hg fall in blood pressure in normotensive individuals (41).

The DASH study showed that the DASH diet (rich in fruit, vegetables, low fat dairy foods, fibre and protein and with reduced quantities of saturated fat and cholesterol) resulted in a reduction in systolic blood pressure by 5.5 mm Hg and diastolic blood pressure of 3.0 mm Hg (42).

A subsequent study showed that the combination of a low salt diet to the DASH diet, showed lowered the systolic blood pressure by 11.5 mm Hg in patients with hypertension and 7.1 mm Hg in non-hypertensive patients. The combination of the two interventions together was as effective as a single antihypertensive agent (43).

The greatest effect on blood pressure due to sodium reduction has been seen in blacks, middle aged and older persons, and in persons with hypertension, diabetes or chronic kidney disease. This subset of persons have been found to have a renin – angiotensin – aldosterone system that is less responsive (44).

Population studies in India have been done to estimate salt intake. The CURES-53 study, estimated the dietary salt consumption in an urban population in South India, and found that the mean daily salt intake was 8.5 grams per day. They also found that those with a higher salt intake had a higher prevalence of hypertension. Increase in dietary salt was seen to correlate with increases in both systolic and diastolic blood pressures of those with hypertension and also among those with normal blood pressures. They also found a higher prevalence of hypertension among those who added more than a teaspoon of salt a day to their food (45).

Potassium:

Evidence from animal studies, observational studies and meta-analyses of clinical trials have shown that a high potassium intake is associated with lower blood pressure.

This has been seen in both subjects with and without hypertension.

A meta-analysis of 19 studies showed that an increased urinary potassium excretion of 2 grams per day resulted in blood pressure reductions of 4.4/2.5 mm Hg in subjects with hypertension and 1.8/1.0 mm Hg in those without hypertension (46)

Diets that consume more fruits and vegetables are rich in potassium and with the added benefit of other nutrients that they contain are recommended over potassium containing supplements.

The effect that potassium has on blood pressure, has been found to depend on concurrent salt intake, with the greatest blood pressure lowering effect of increased potassium intake seen at higher levels of salt consumption. The opposite also being true with the maximal reduction in blood pressure due to decreased salt intake being maximal at low potassium intake.

Alcohol consumption and hypertension

Alcohol intake is associated with a direct dose-dependent relationship with hypertension, with this effect being seen once the quantity of alcohol increased to more than two drinks a day. The relationship between alcohol and hypertension has been found to be independent of other factors like age, salt intake and obesity.

Some studies have also shown that drinking less than or equal to two drinks a day, may reduce the risk of coronary heart disease.

A meta-analysis of fifteen RCTs showed that a decrease in alcohol consumption resulted in reduced systolic and diastolic blood pressure by 3.3/2.0 mm Hg. These reductions were seen in both hypertensive and non-hypertensive subjects (47).

As per current guidelines, alcohol consumption should be limited to less than two standard drinks in men and one drink in women and lighter-built persons.

Saturated fats

Prospective studies like the Nurses' Health Study and the Health Professional Follow up Study did not find an association between saturated fat and hypertension (48,49). Most trials that have tested the role of fat on hypertension have usually combined reduced saturated fat with increased polyunsaturated fat and have not been able to show an effect.

Fibre

Dietary fibre consists of the indigestible parts of plants in food. Evidence is still varied on the effect of fibre on blood pressure. A large number of studies that have looked at various foods and their effect on blood pressure, have

A meta-analysis of trials has found that increased fibre intake in the form of supplemental fibre was associated with a reduction in systolic and diastolic blood pressure of 1.6/2.0 mm Hg (50). This could not be substantiated in a randomized

clinical trial. It suffices to say that at present the data on the effect of dietary fibre on blood pressure is insufficient and further studies are needed.

METHODS AND MATERIALS

4 Methodology

4.1 Study setting:

The study was conducted in the Department of General Medicine at the Christian Medical College Hospital, Vellore.

4.2 Study design:

This is a prospective descriptive study.

4.3 Study period:

September 2014 to September 2015.

4.4 Inclusion criteria:

1. Patients presenting with hypertension, diagnosed between the ages of 18 and 40, attending the General Medicine Outpatient department.

2. The cut off for hypertension as per the JNC 7 guidelines is taken as a BP of ≥ 140/90mmHG. This is to be the average of two readings.

3. Patients may already have been evaluated for a secondary cause or may be undergoing evaluation.

4.5 Exclusion criteria:

1. Subjects unwilling to give consent.

2. Pregnant women

4.6 Sample size calculation:

Studies on the epidemiology of secondary causes of hypertension in the young in India are sparse. A study conducted by Raluca et al in Romania (2012) found a prevalence of endocrine causes to be 20% in young hypertensive patients.

This study's prevalence of hypertension has been used to calculate the sample size.

p: 20%

q: 80%

d: being the allowable error = 6

Using the formula: 4pq/d2

The sample size was calculated to be 178.

4.7 Method of recruitment:

Approval was obtained from the Institutional Review Board and Ethics committee.

(IRB Min No 9079).

Patients presenting to the General Medical OPD at the Christian Medical College Hospital were recruited based on the case definition and eligibility criteria.

The recruitment was based on convenience sampling.

4.8 Method of evaluation:

1. Informed consent was obtained and patient confidentiality assured.
2. A questionnaire was used to collect details with regards to demography and the history of hypertension.
3. A detailed clinical examination was performed.
4. Measurements of height, weight, blood pressure, hip circumference, waist circumference and body composition were taken.
5. A stress questionnaire was administered.
6. A dietary evaluation was done by a dietician
7. An exercise evaluation was done by a physiotherapist.
8. Laboratory test results were obtained from the electronic medical records.

Measurements taken:

Blood pressure:

The auscultatory method of blood pressure measurement was taken with a properly calibrated and validated instrument. Subjects were quietly seated for at least 5 minutes in a chair, with both feet on the floor and the arm supported at the level of the heart. An appropriate sized cuff (with the cuff bladder encircling at least 80% of the arm) was used. An average of two measurements were taken. The systolic blood pressure was taken at the point when the first of two or more sounds are heard and the diastolic blood pressure the point just before the disappearance of the Korotkoff sounds.

Height:

This was measured using a validated calibrated measuring scale. Measurements were taken to the nearest centimetre.

Weight:

This was measured using a validated calibrated weighing scale. Measurements were taken to the nearest kilogram.

Waist circumference:

This was measured using an inch tape, and as per the WHO, the measurement was taken at the midpoint between the lowest palpable rib and the top of the iliac crest.

The subject was standing, arms by the side, with the feet together and with the weight distributed evenly across the feet.

Hip circumference:

This was measured using an inch tape, with the measurement being taken at the widest portion of the buttocks, with the tape parallel to the ground. The subject was standing, arms by the side, with the feet together and with the weight distributed across the feet.

General physical examination:

A Physical examination was conducted with special emphasis to the following:

1. Acanthosis nigricans

2. Signs of hypothyroidism

3. Signs of hyperthyroidism

4. Signs of Cushing's syndrome

5. Renal artery bruit

5. Peripheral pulses

Body fat analysis:

This was done using a validated body fat analyser.

Stress assessment:

The tool used to assess stress was the Cohen perceived stress questionnaire. This is a ten question questionnaire that assess perceived stress over the past month. This was administered by the Principal investigator.

Dietary assessment:

A ten part food frequency questionnaire was administered by a dietician. Dietary practices based on the DASH (Dietary approaches to stop hypertension) diet were incorporated into the questionnaire. These included salt, fruit and vegetable, saturated fat intake.

Physical activity assessment:

This was done by a physiotherapist, who administered the Long form of the International Physical Activity Questionnaire (IPAQ). Assessment of physical activity in the following domains were made:

1. Leisure time

2. Domestic and gardening activities

3. Work – related and transport – related activities.

Based on this, the Metabolic equivalents (Mets) were calculated and physical activity grouped into low (less than 600 Mets), medium (600 to 3000 Mets) and high (more than 3000 Mets).

DATA variables assessed:

The following variables were assessed:

A. Demographic details:

a. Age

b. Sex

c. Age of onset

d. Residence

B. History pertaining to hypertension:

a. Duration of hypertension

b. Symptoms at onset

c. Anti-hypertensive use

C. Risk factors for hypertension:

a. Family history of hypertension

b. Other drug use

c. History of diabetes mellitus

d. History of Dyslipidaemia

e. History of smoking

f. History of alcohol use

g. Symptoms of Pheochromocytoma

h. Symptoms of Hypothyroidism

i. Symptoms of hyperthyroidism

j. Symptoms of Cushing's syndrome

k. Symptoms of Obstructive sleep apnoea

l. Symptoms of chronic renal failure

D. Measurements:

a. Height

b. Weight

c. Waist circumference:

For men, a waist circumference more than 90 centimetres and for women more than 80 centimetres was taken as a cut-off for central obesity.

d. Hip circumference

e. Waist-hip ratio:

For men a cut-off of more than 0.9 was taken as suggestive of central obesity and for women a cut-off of 0.85 was taken.

Body mass index (BMI): The indexes for the same were as per the WHO guidelines for BMI for Asians:

Underweight: < 18.5 Kg/Mt²
Normal: 18.5 – 22.9 Kg/Mt²
Overweight: 23 to < 25 Kg/Mt²
Obesity I: 25 to 29.9 Kg/Mt²
Obesity II: ≥ 30 Kg/Mt²

f. Blood pressure

g. Percentage body fat:

In men, a percentage of body fat above 25% was considered high and for women above 32%.

g. General physical examination for acanthosis nigricans, signs of hypothyroidism, hyperthyroidism, Cushing's syndrome, renal artery bruit and peripheral pulses.

E. Stress assessment

F. Dietary evaluation

G. Physical activity assessment

H: Laboratory parameters:

This data was obtained from the electronic medical records and comprised the following:

a. Creatinine

b. Fasting sugars

c. Post prandial sugars

d. HbA1c

e. TSH

f. 8AM cortisol

g. Urine metanephrines

h. Electrocardiogram:

Left ventricular hypertrophy was assessed by the Sokolov- Lyon criteria:

S wave depth in V1 + the tallest R wave height in leads V5/V6 to be > 35 mm

i. Echocardiogram

j. Renal artery Doppler

k. Serum potassium

l. Serum fasting lipids

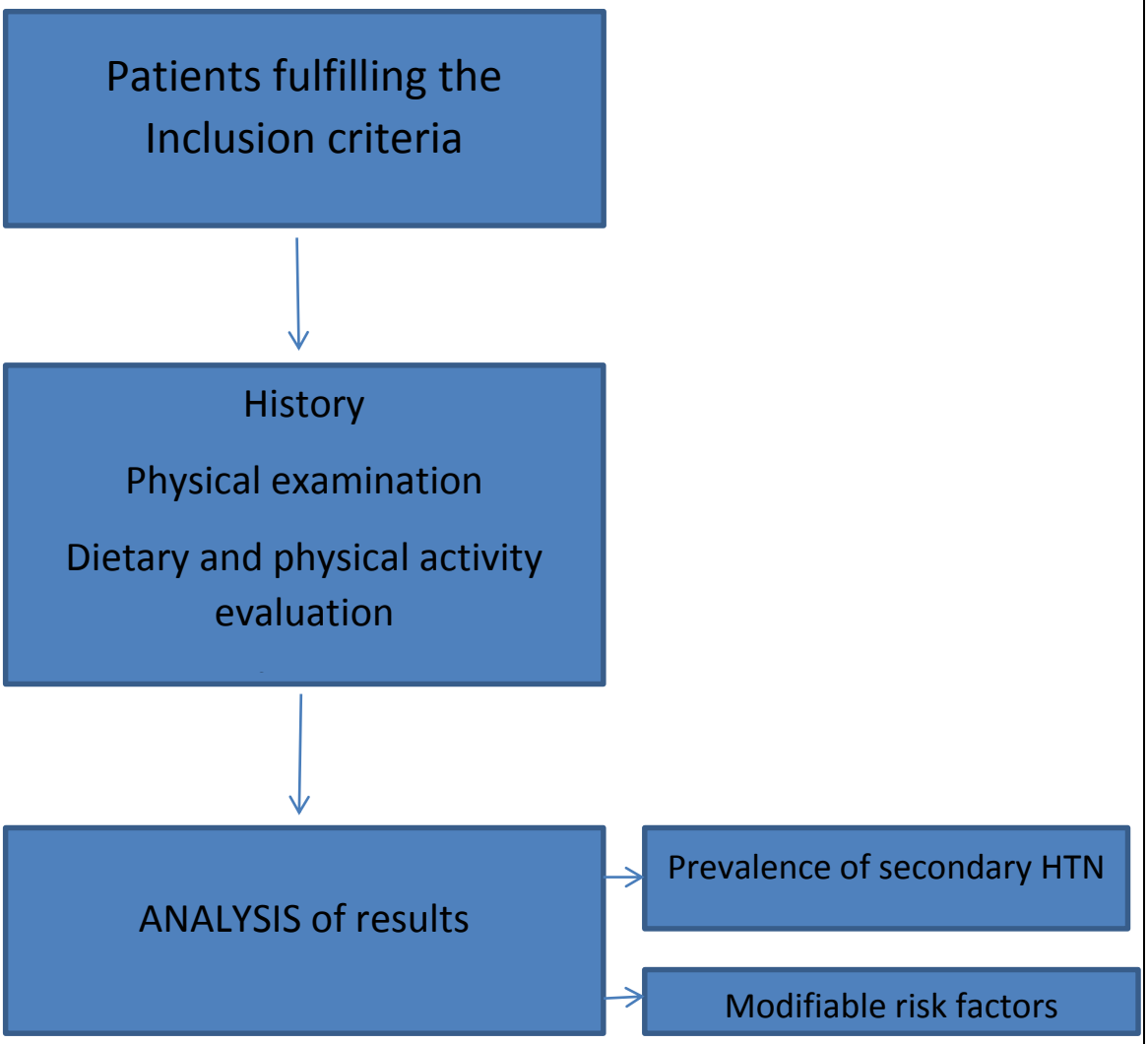
Statistical Analysis:

Demographic data was analysed with descriptive statistics. Continuous variables were expressed as mean ± SD, or median with range. Categorical variables were expressed as frequencies and percentages. Comparison of different groups based on categorical variables was done by Chi- square test.

Comparison of different groups was done by the two-tailed t test and Mann-Whitney test. $P < 0.05$ was be considered to be statistically significant.

RESULTS

Figure 1: Study flow diagram:



5 Results:

5.1 Distribution of Primary and Secondary hypertension

The following is a description of the young hypertensive patients included in this study. 85 patients were included in this study from September 2014 to September 2015. There were 54 men and 31 women.

Nine (10%) of the patients were newly diagnosed with hypertension and another 9 (10%) had been recruited within a month of diagnosis. Of the 85 patients, 9 (11%) were found to have a secondary cause for the hypertension and the remaining were categorised as having Primary hypertension.

The patients were evaluated by a limited screen for secondary causes of hypertension. Based on this, the distribution of primary and secondary causes is as follows:

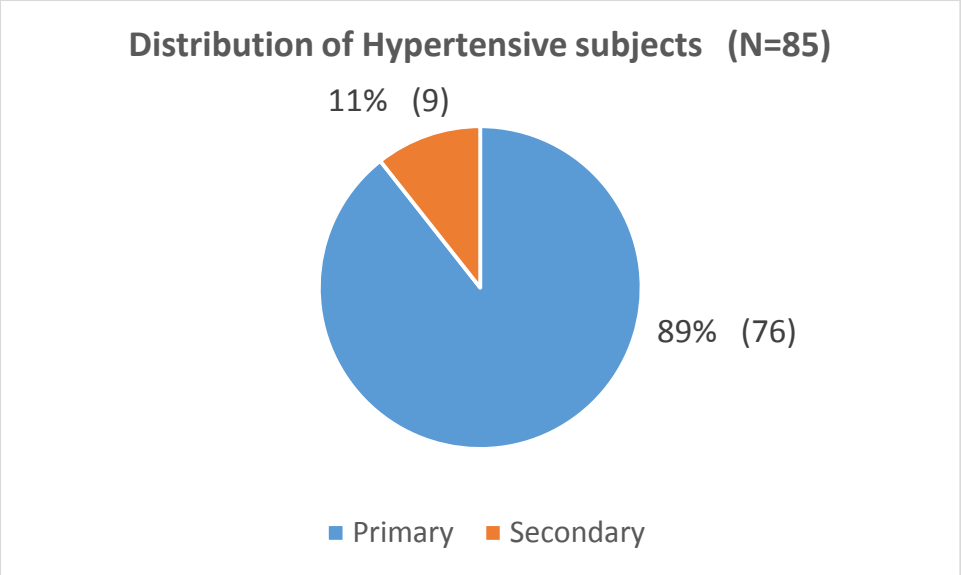


Figure 2: Distribution of hypertensive subjects (N=85)

5.2 Geographic distribution of the Subjects:

CMCH is a tertiary hospital and caters to patients from all over the country as well as those from neighbouring countries. Approximately 36% of the subjects were from Tamil Nadu, this was followed in number by subjects from West Bengal and Bangladesh.

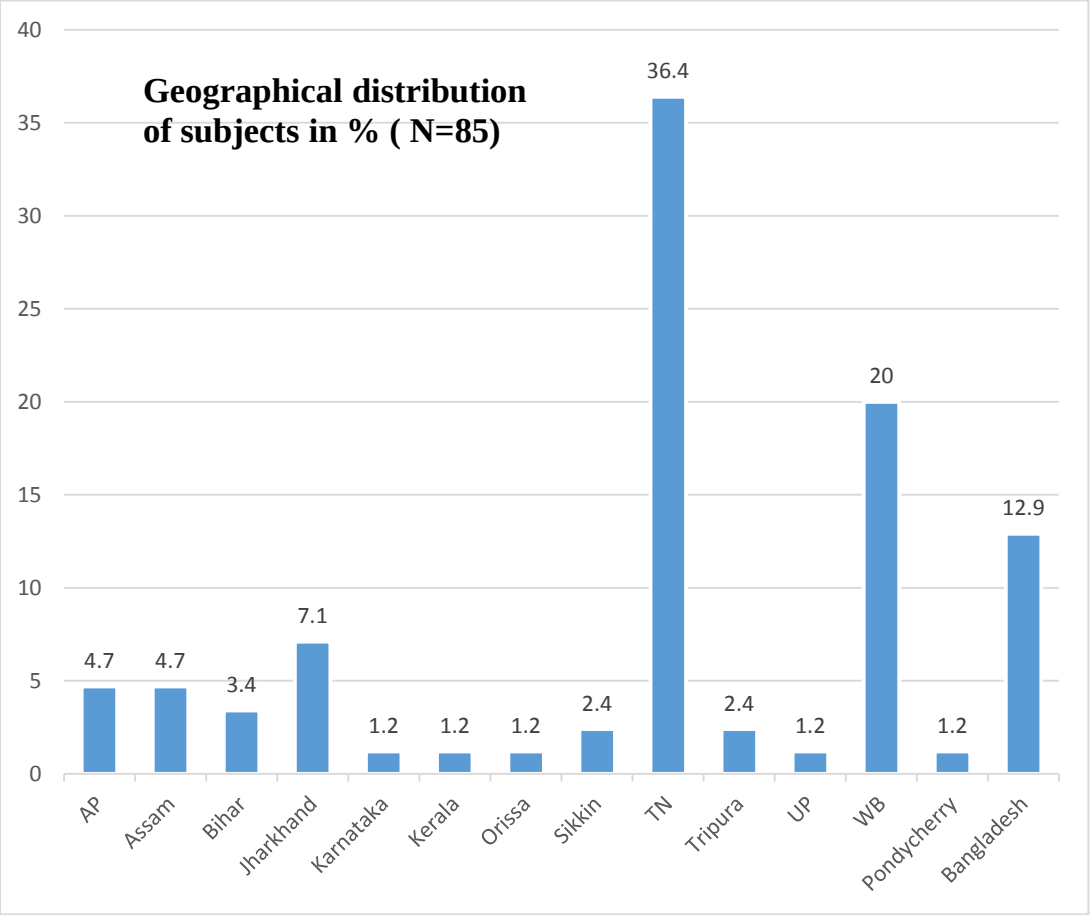


Figure 3: Geographical distribution of subjects (N=85)

5.3 Duration of hypertension:

The duration of hypertension was less than a year in approximately half the study group. And only 15% had a duration of hypertension that was more than 6 years.

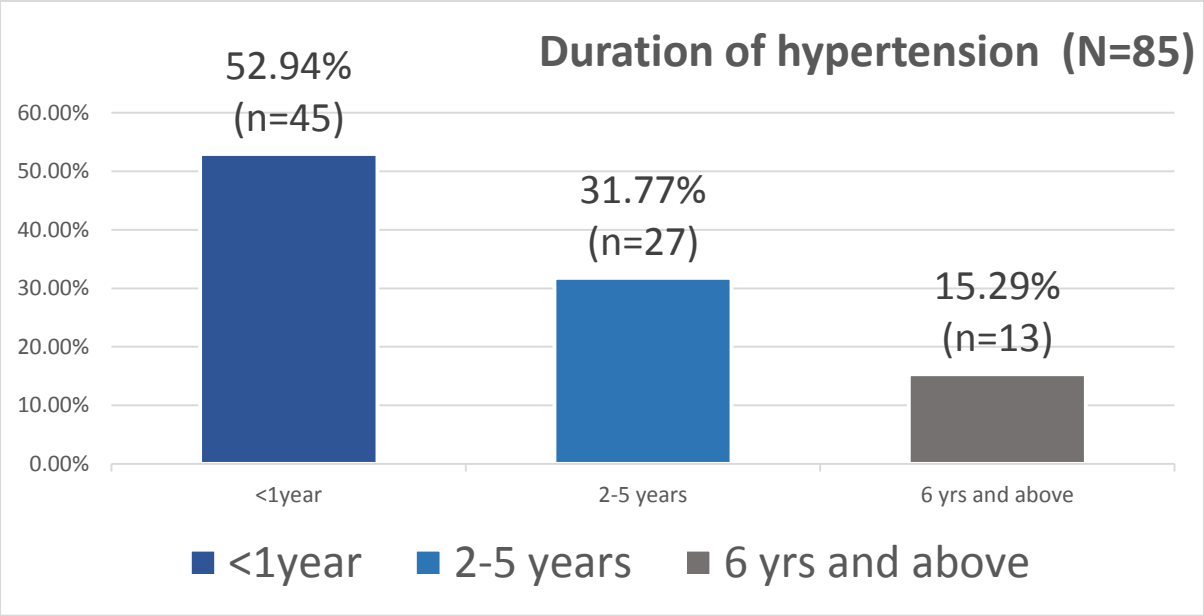


Figure 4: Duration of hypertension (N=85)

5.4 Evaluation for secondary hypertension

Of the 85 study subjects, 11% (9) were found to have a secondary cause for the hypertension. Of the 85 subjects, in the study, the following is the distribution of tests done.

History:

Part of the history obtained from subjects, pertained to that of symptoms due to a Secondary cause. Of the 85 subjects, 8, had a history suggestive of obstructive sleep apnoea (using the STOP BANG screen), 6 had a history suggestive of pheochromocytoma (paroxysms of headache, palpitations and tremors) and 1 had symptoms suggestive of hypothyroidism.

Sl No	History suggestive of secondary hypertension	Number
1	Symptoms of renal disease	0
2	Symptoms of Cushing's syndrome	0
3	Symptoms of pheochromocytoma	6
4	Symptoms of hyperthyroidism	0
5	Symptoms of hypothyroidism	1
6	Symptoms of obstructive sleep apnoea	8

Examination:

On examination, 17 subjects, were found to have acanthosis nigricans. One subject each had signs of hypothyroidism and Cushing's syndrome.

Sl No	Signs on examination	Number
1	Acanthosis nigricans	17
2	Signs of hyperthyroidism	0
3	Signs of hypothyroidism	1
4	Signs of Cushing's syndrome	1
5	Renal bruit	0
6	Absent peripheral pulses	0

Laboratory Investigations:

A limited secondary hypertension screen was done for most subjects. All tests were not done for subjects, as these were tests that were done at the discretion of the treating physician.

Sl No	Test	Number
1	Creatinine	80
2	Potassium	60
3	Urine sediments	56
4	Renal artery Doppler	36
5	Total cholesterol	63
6	Triglycerides	64
7	HDL	63
8	LDL	68
9	Fasting glucose	63
10	Post prandial glucose	58
11	HbA1c	12
12	TSH	66
13	Cortisol	34
14	Urine metanephrines	52
15	ECG	54
16	ECHO	24

5.5 Symptoms at presentation:

Of the 85 subjects, hypertension was detected incidentally in 60% (51). 35% (30) had CNS symptoms at presentation. Of these, 16% (14) had dizziness, 13% (11) had headache and 6% (5) had a cerebrovascular accident.

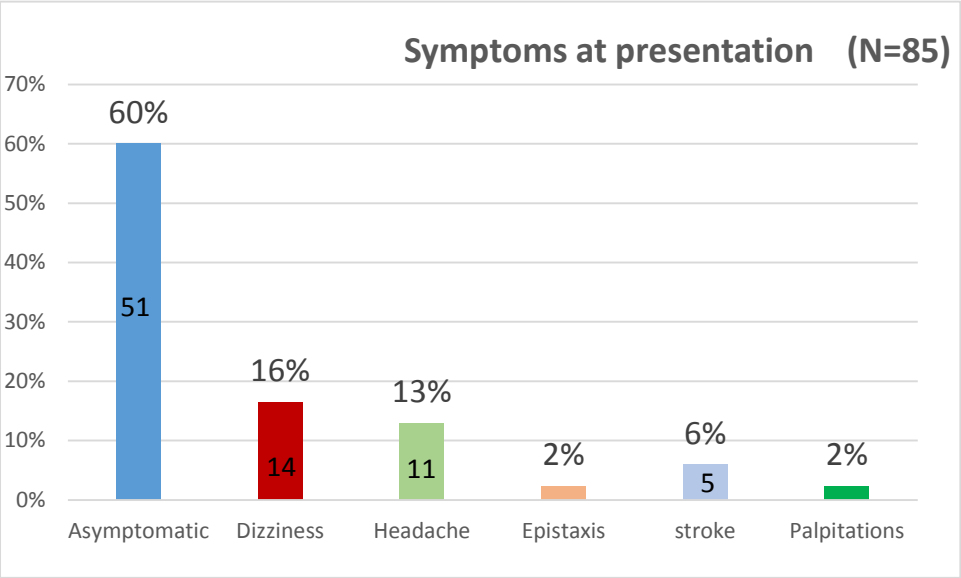


Figure 5: Symptoms at presentation (N=85)

5.6 Profile of patients with Secondary hypertension:

Sl No	Symptoms	Signs	Investigations	Diagnosis
1	Pedal edema x 1 year	Obese Acanthosis nigricans	TSH 99.9 uIU/ml Anti-thyroglobulin Ab:27 IU/ml Anti-microsomal AB:585 IU/ml	Primary hypothyroidism
2	Exertional dyspnoea x 2 years	Pallor	Creatinine:6mg % Urea: 56mg% Hb 7.2 gm/DL	Chronic kidney disease
3	Dizziness x 6 months	-	Creatinine:8.4 mg% Urea: 118mg% Hb:5.9GM/DL USG: Bilateral kidneys showed grade II parenchymal changes	Chronic kidney disease
4	Headache x 5 days	-	Creatinine:3.5mg% Urea: 54 mg% Proteinuria:1.4G/24 hours USG: Bilateral grade II renal parenchymal changes	Chronic kidney disease Renal biopsy: Arteriolonephrosclerosis with chronic interstitial nephritis
5	Headache x 6 months	CVS: EDM at the aortic area	ECHO: Severe Aortic regurgitation	Aortic regurgitation (severe)
6	Increased weight gain x 7 years Proximal weakness x 1 month Over the counter medication use +	Cushingoid facies Dorsocervical pad of fat Proximal weakness	8 Am Cortisol: 0.28 ug%	Exogenous Cushing’syndrome

7	Headache Blurring of vision Seizures	-	Creatinine: 0.85mg% Urine Protein: 3G/24 hours	Nephrotic syndrome Renal biopsy: Dense deposition disease
8	Asymptomatic	-	TSH 25uIU/ml	Primary hypothyroidism
9	Asymptomatic	-	TSH 60 uIU/ml	Primary hypothyroidism

5.7 Profile of patients with Primary hypertension:

1) Demographic details:

a) Age:

In those with Primary hypertension, 72% (55) of the patients were between the age groups of 31 and 40 and 28% (21) were between the age groups of 18 to 30 years.

The age of onset of hypertension was less than thirty years in 45% (34) of the subjects and over the age of thirty in 55% (42).

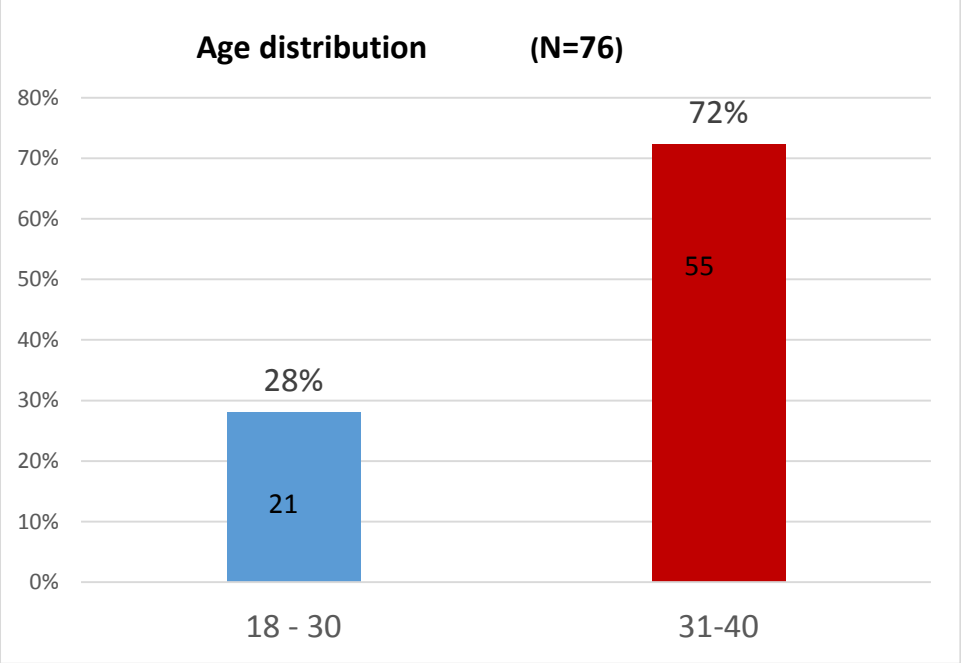


Figure 6: Age distribution (N=76)

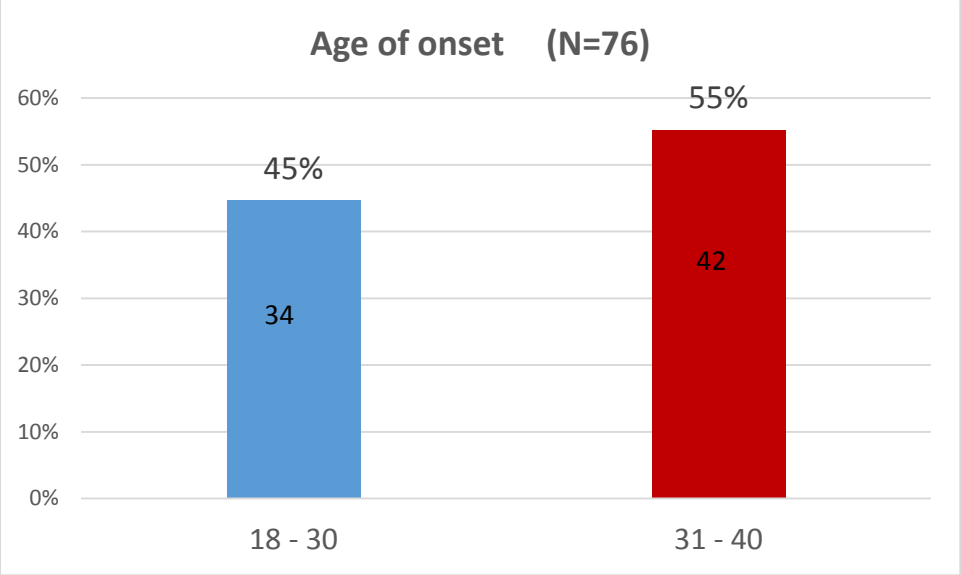


Figure 7: Age of onset (N=76)

b) Gender:

Among the 76 subjects with Primary hypertension, there were more men than women with 64% (49) men and 36% (32) women.

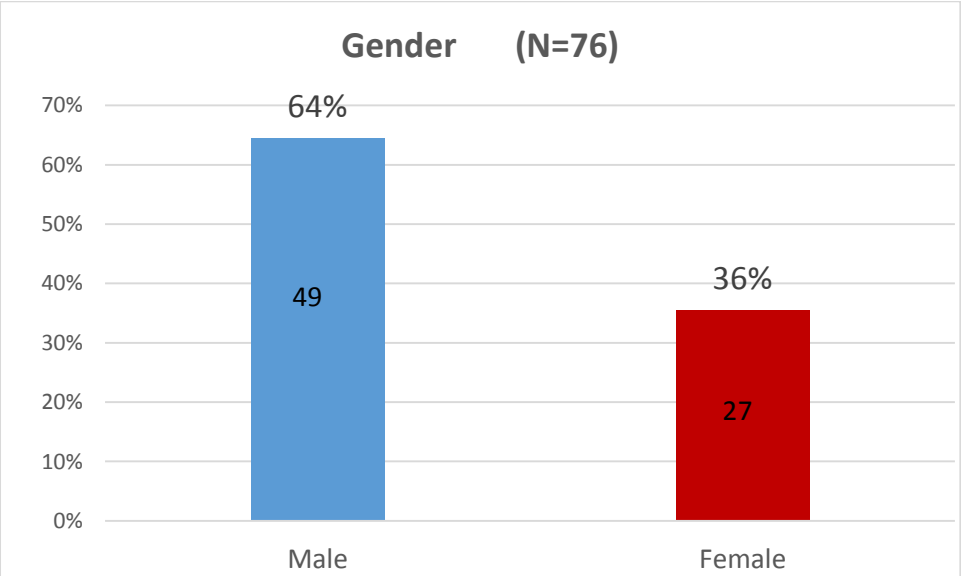


Figure 8: Gender (N=76)

c) Residence:

With regards to the nature of residence, 66% (50) were from an Urban residence and 34% (26) were from a Rural residence.

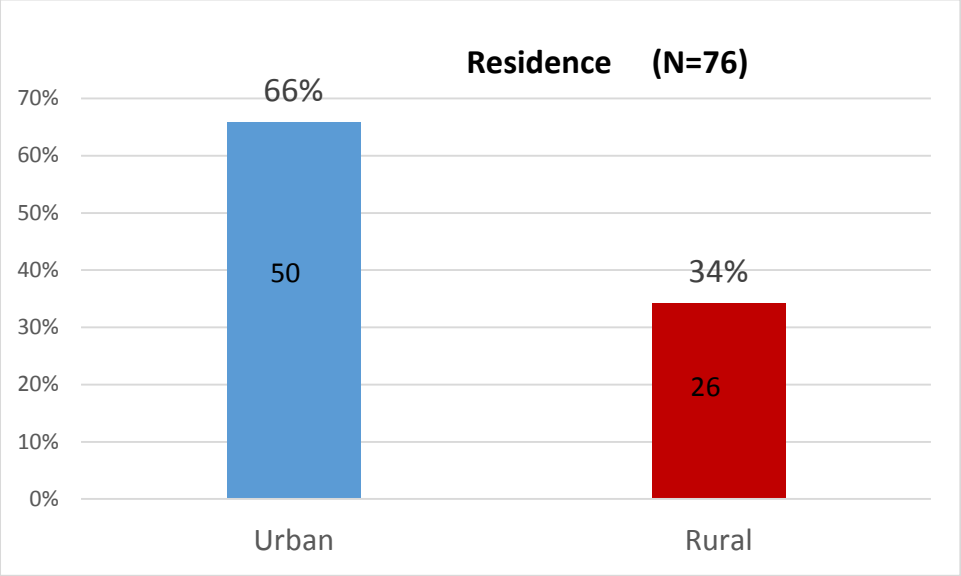


Figure 7: Residence (N=76)

2) Risk factors:

a) Family history of hypertension:

There was a positive family history of hypertension in 70% (53) of the subjects with primary hypertension as compared to 30% (23) who did not.

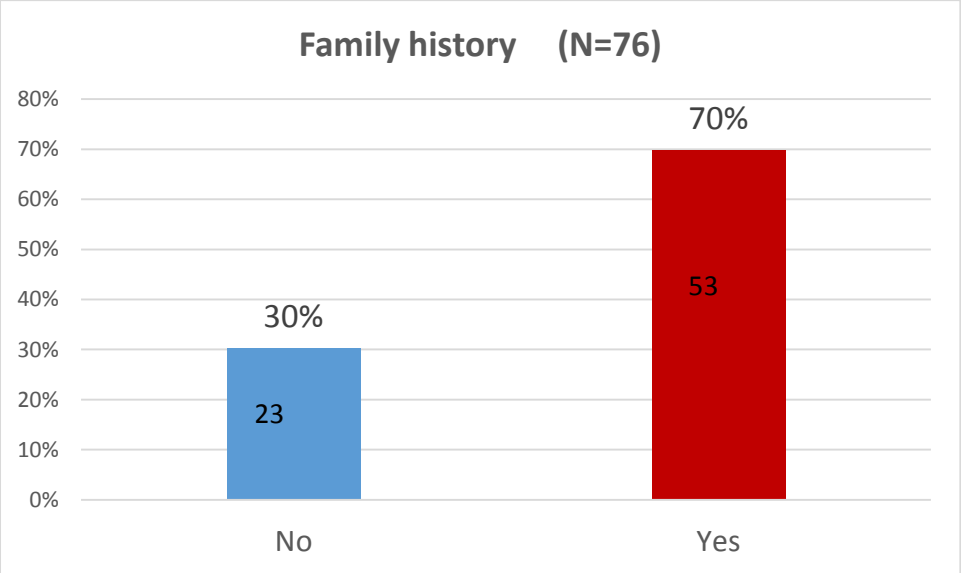


Figure 8: Family history of hypertension (N=76)

b) Diabetes mellitus:

Of the 76 patients with primary hypertension, 8 (11%) had co existing diabetes mellitus as well.

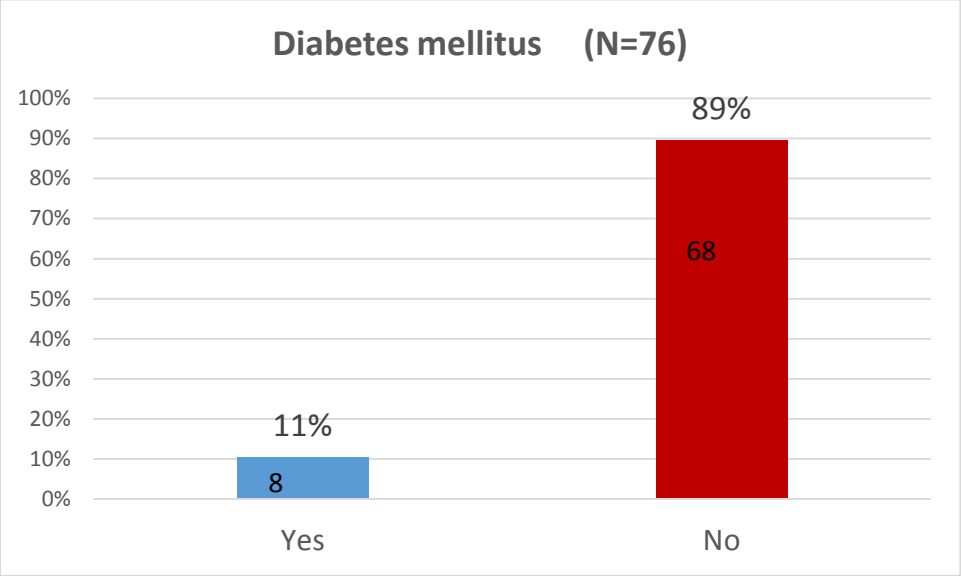


Figure 9: Diabetes mellitus (N=76)

c) Dyslipidaemia:

Among those with primary hypertension, 39% (30) also had dyslipidaemia and 61% (46) did not.

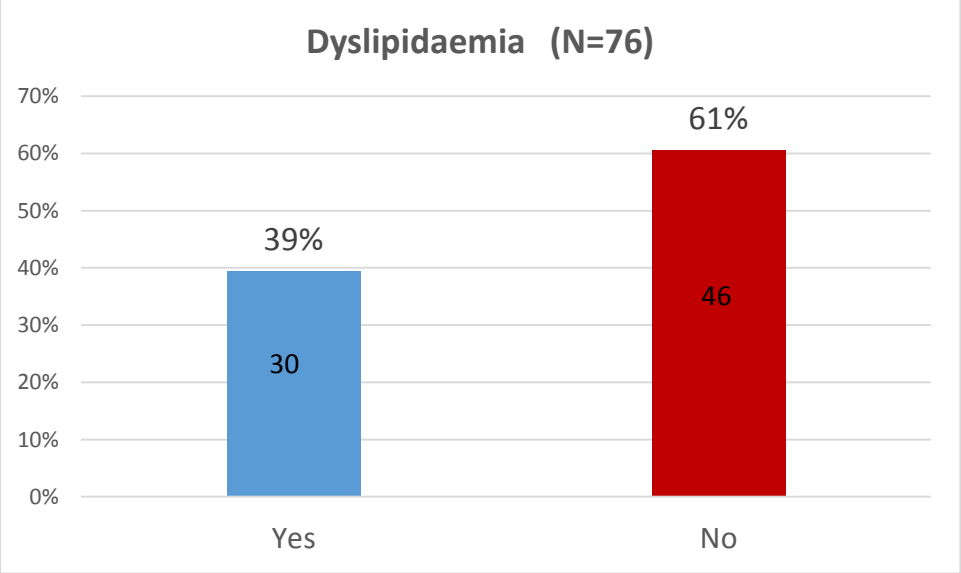


Figure 10: Dyslipidaemia (N=76)

d) Obesity:

The number of obese subjects was 61% (47) among those with primary hypertension.

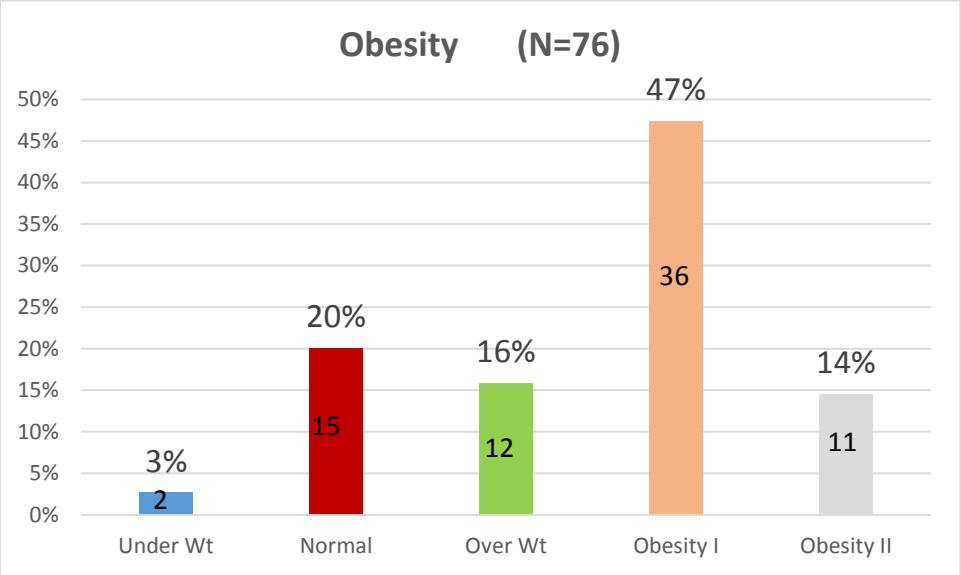


Figure 11: Obesity (N=76)

e) Waist circumference:

Among men, 65% (28) had a waist circumference that was more than 90 centimetres and 35% (15) had a waist circumference that was less than 90 centimetres. Among women, 81% (22) had a waist circumference that was more than 80 centimetres and 19% (5) had a waist circumference that was less than 80 centimetres.

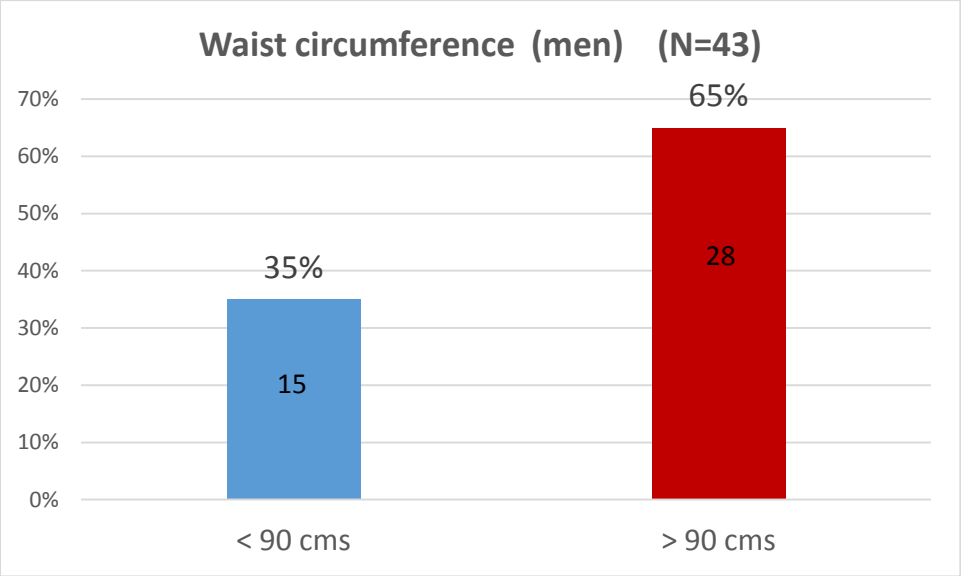


Figure 12: Waist circumference (Men) (N=43)

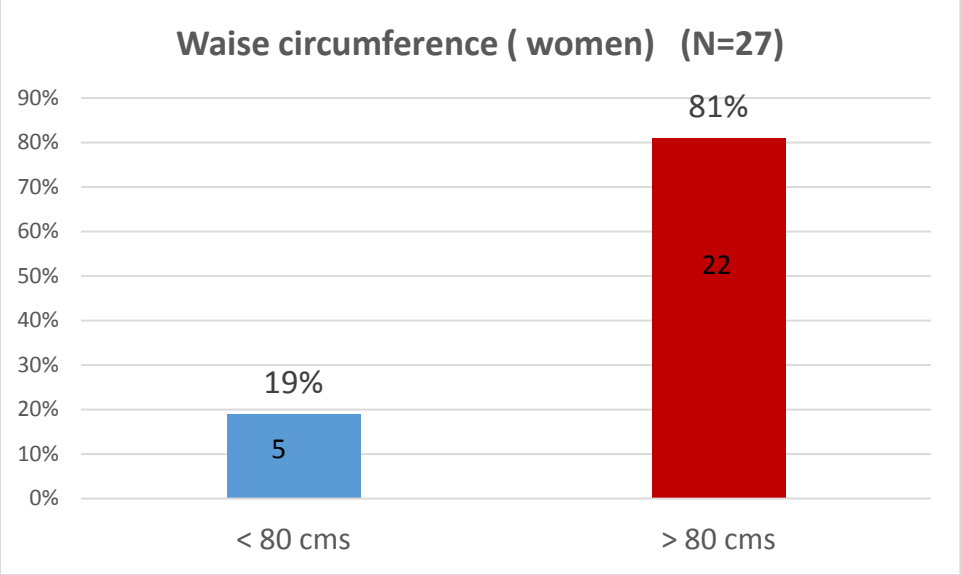


Figure 13: Waist circumference (women) (N=27)

f) Waist-hip ratio:

Among men, 74% (32) had a waist- hip ratio that was more than 0.9 and 26% (11) had a waist-hip circumference that was less than 0.9. Among women, 64% (16) had a waist-hip ratio that was more than 0.85 and 36% (9) had a waist-hip circumference that was less than 0.85.

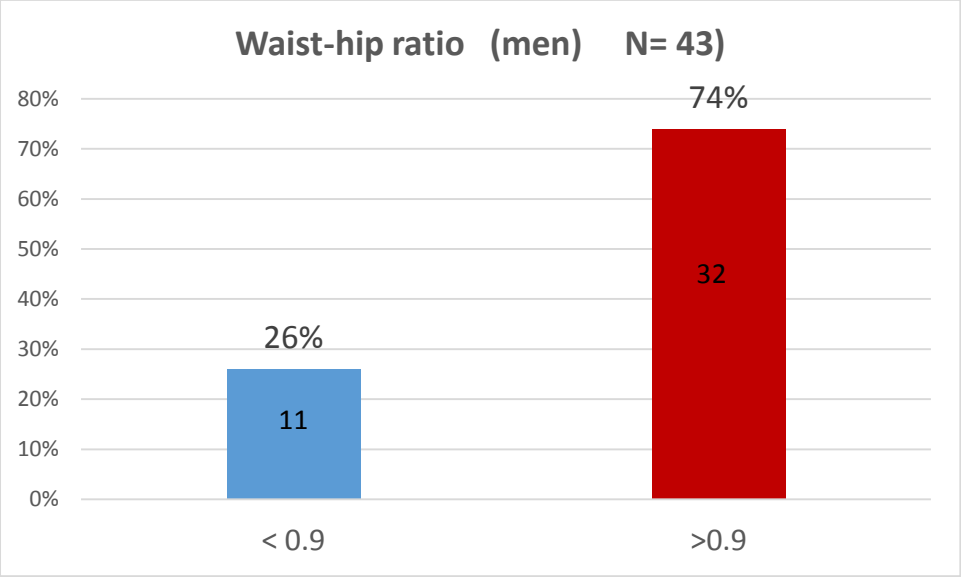


Figure 14: Waist-hip ratio (Men) (N=43)

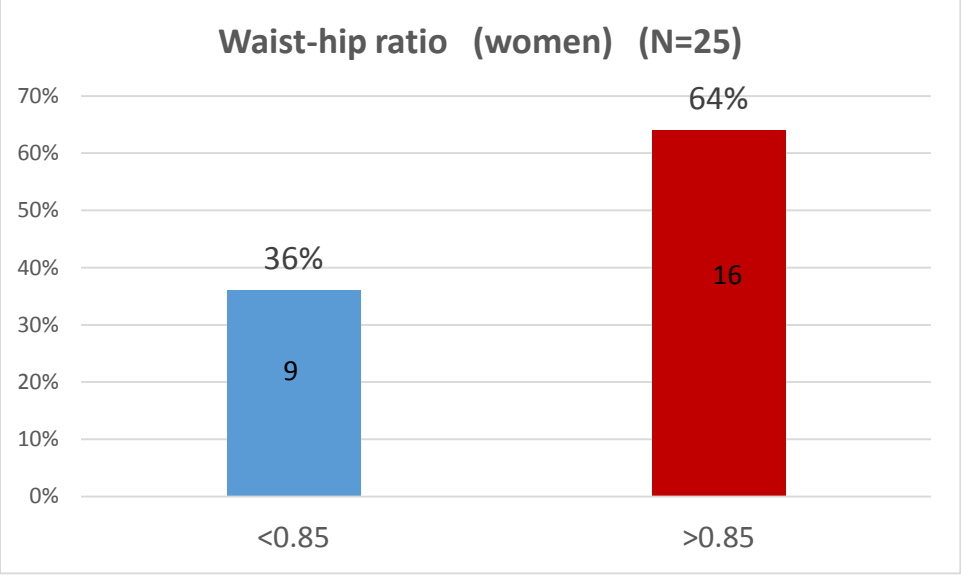


Figure 15: Waist-hip ratio (Women) (N=25)

g) Percentage body fat:

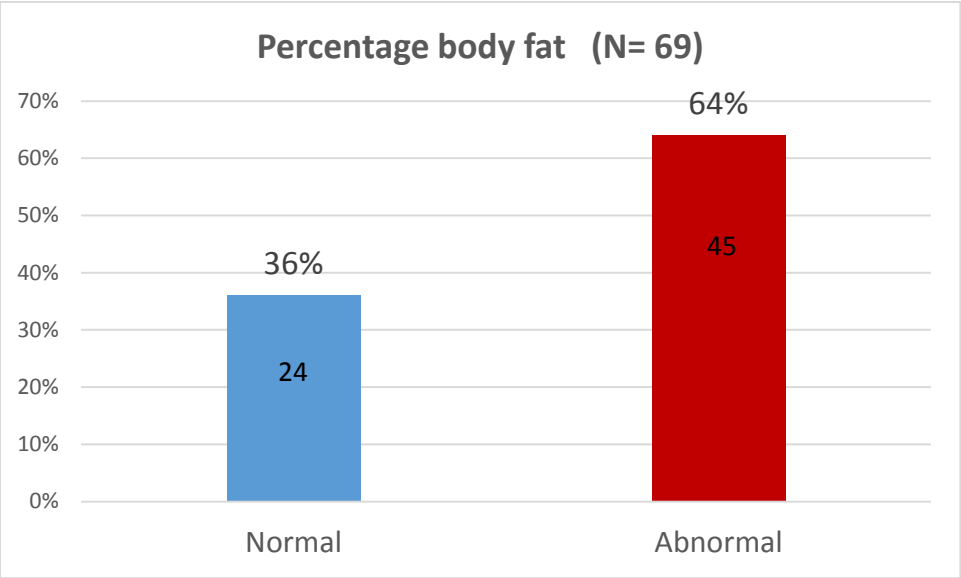


Figure 16: Percentage body fat (N=69)

h) Alcohol use and hypertension:

Alcohol use was reported in 16% (12) of the subjects with primary hypertension.

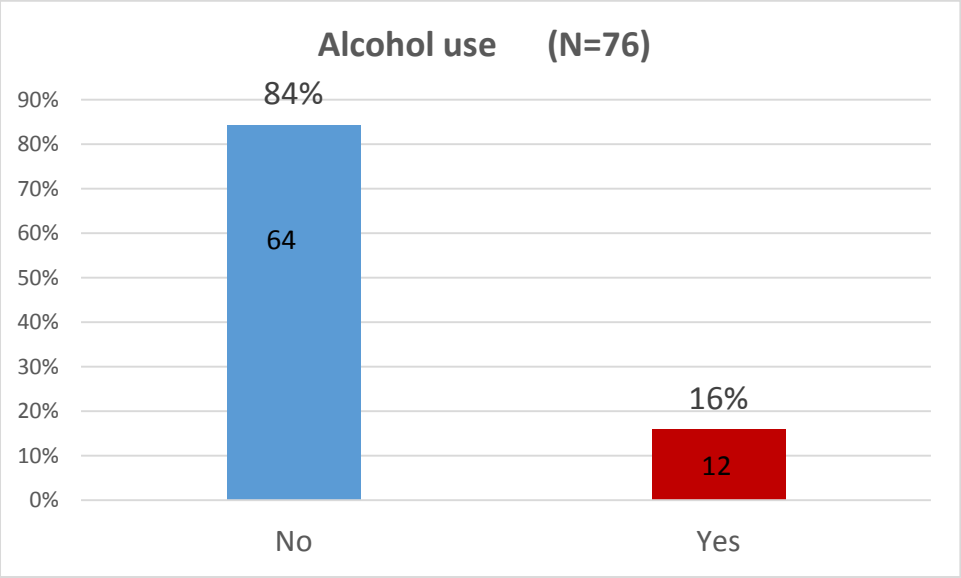


Figure 17: Alcohol use (N=76)

i) Tobacco use and hypertension:

Tobacco use: Of the 76 subjects, tobacco use was documented in 16% (12).

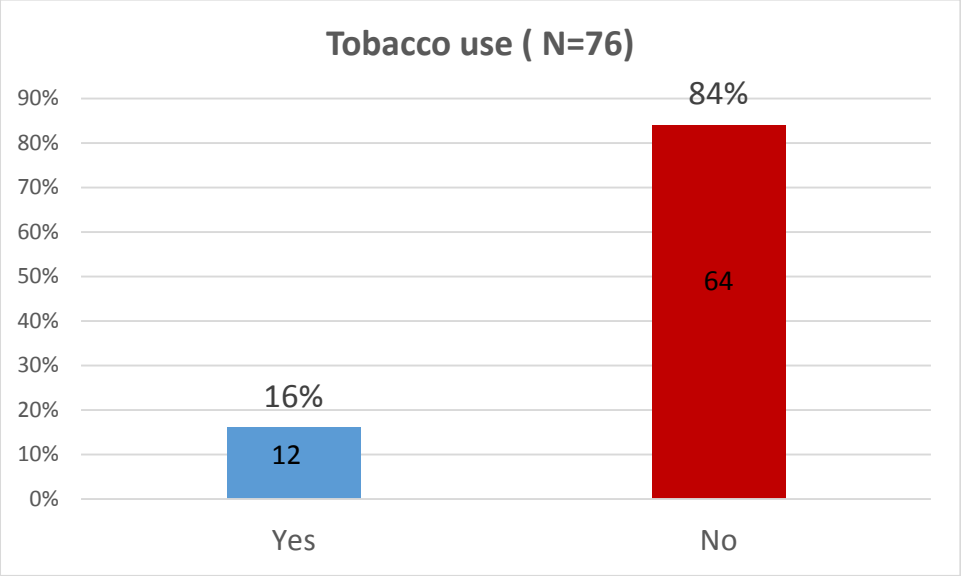


Figure 18: Tobacco use (N=76)

j) Stress:

Among those with Primary hypertension, High stress was perceived in 46% (30) and low stress in 54% (35).

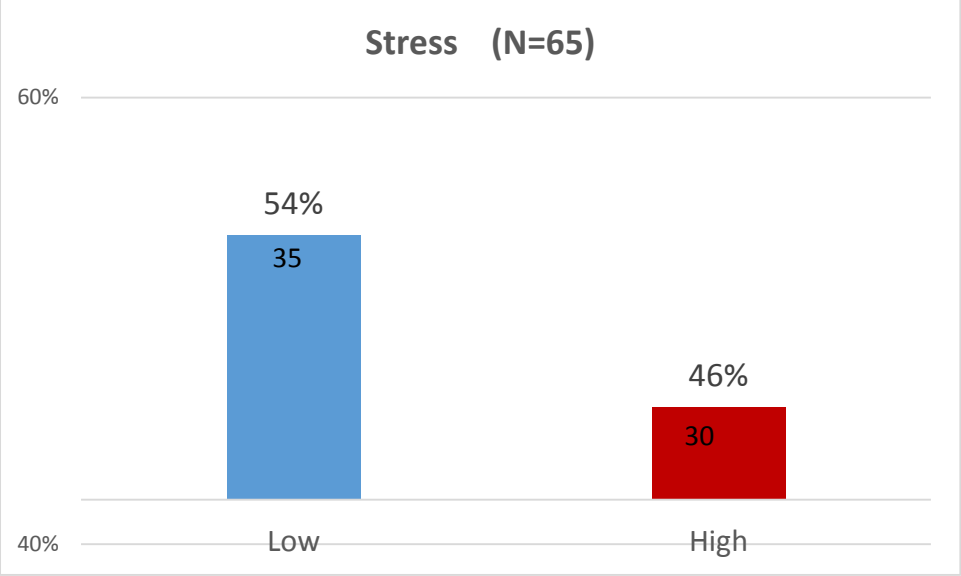


Figure 19: Stress (N=65)

k) Physical activity and hypertension:

Of the 42 patients who underwent a physical activity evaluation, 29% (12) had low levels of activity, 45% (19) had medium levels of activity and 26% 11) had high levels of activity.

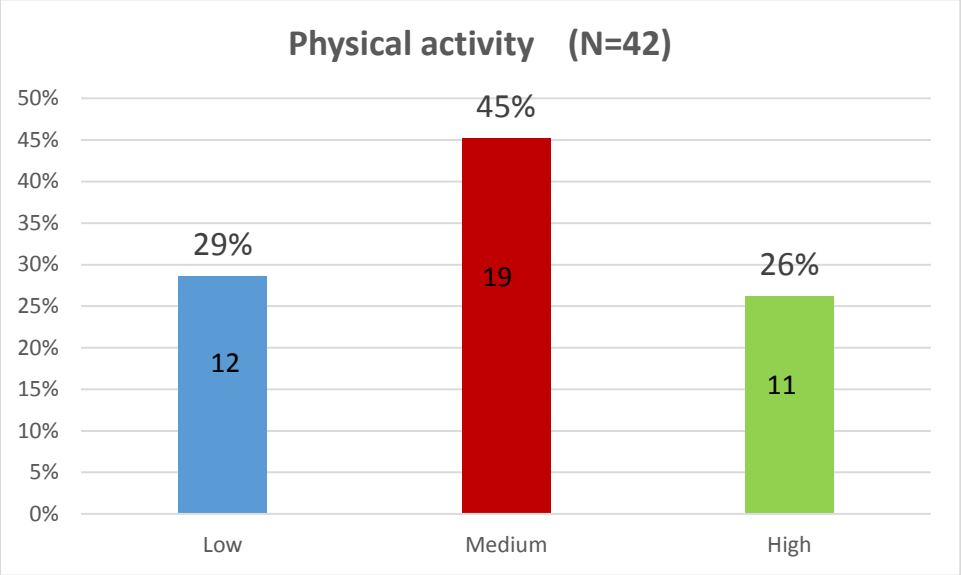


Figure 20: Physical activity and hypertension (N=42)

k) Added salt:

Of the 55 patient who underwent a dietary evaluation, 91% (50) added salt to their food and 9% (5) did not.

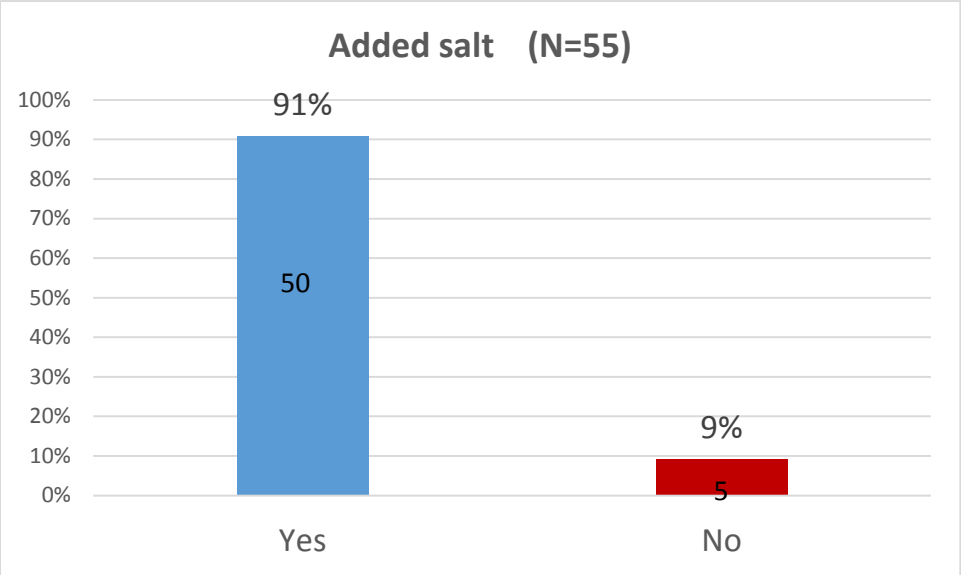


Figure 21: Added salt (N=55)

l) Fruit and vegetable servings per day

Of the 55 subjects who underwent a dietary evaluation, 55% (30) consumed less than three servings of fruit and vegetables per day as compare to 45% (25) who consumed more than three servings per day.

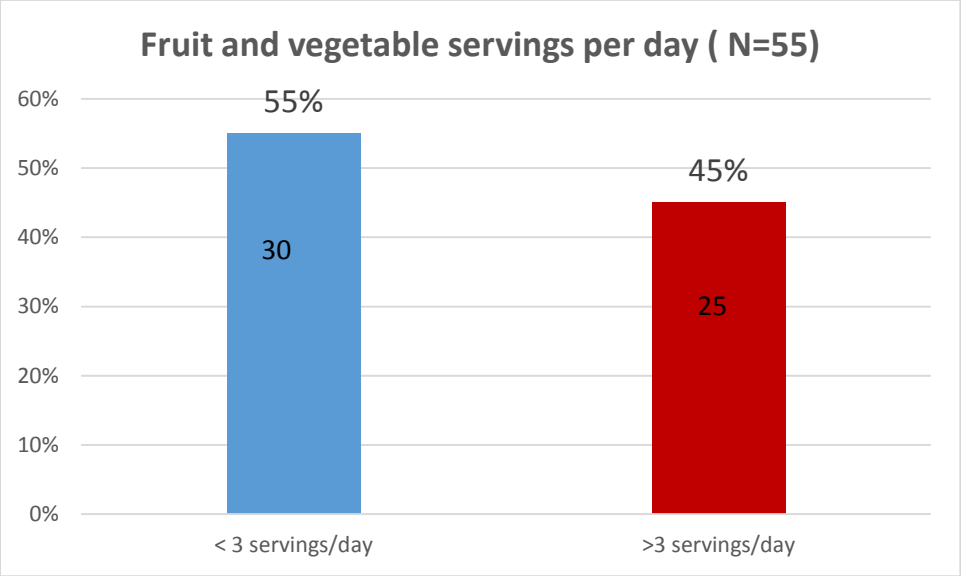


Figure 22: Fruit and Vegetable servings per day (N=55)

3) Target organ damage:

Left ventricular hypertrophy: Of the 54 subjects who underwent an electrocardiogram, 37% (20) had left ventricular hypertrophy, while 63% (34) did not.

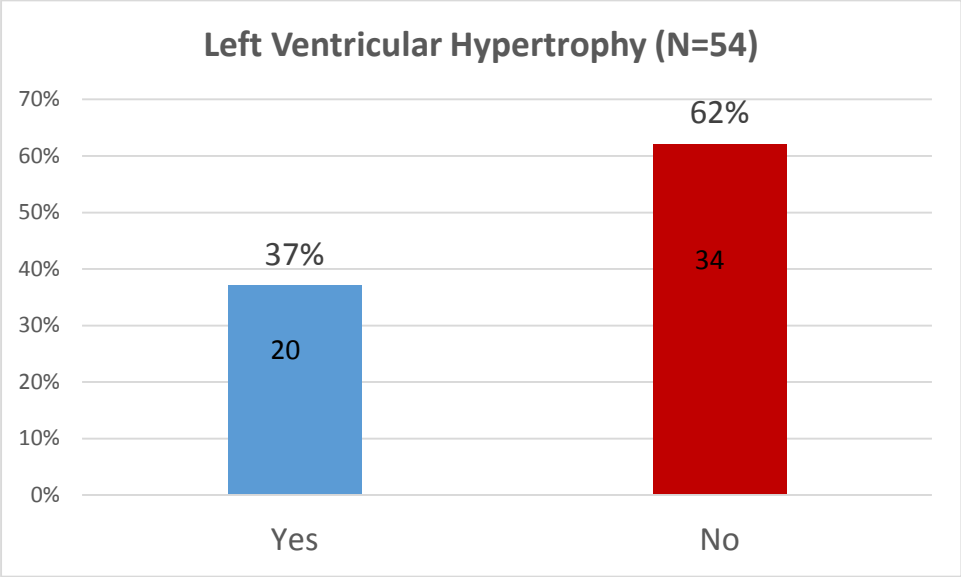


Figure 23: Left ventricular hypertrophy (N=76)

4) Control of blood pressure:

Among the 76 subjects, only 40% (30) were well controlled (blood pressure < 140/90 mm Hg), the remaining 60% (46) were not well controlled.

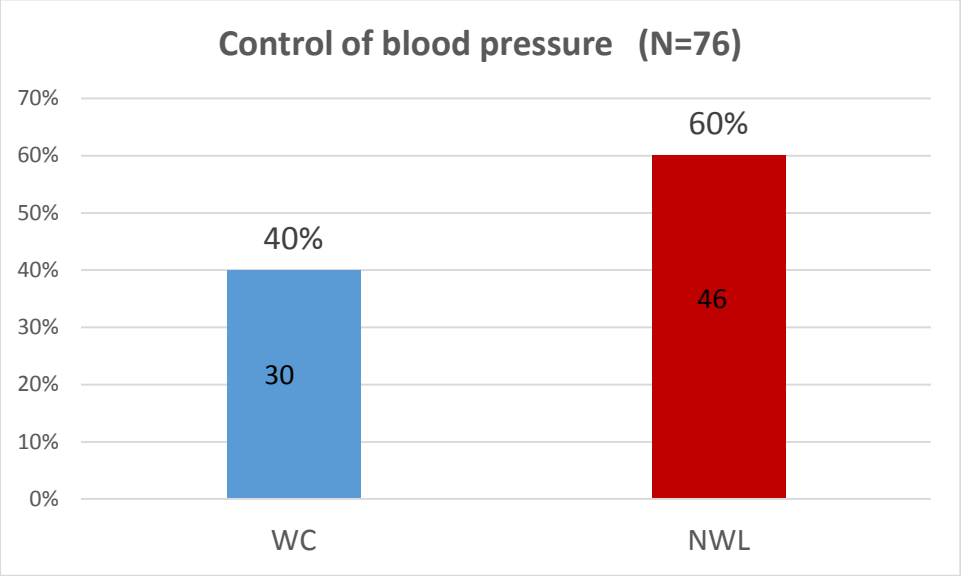


Figure 24: Control of blood pressure

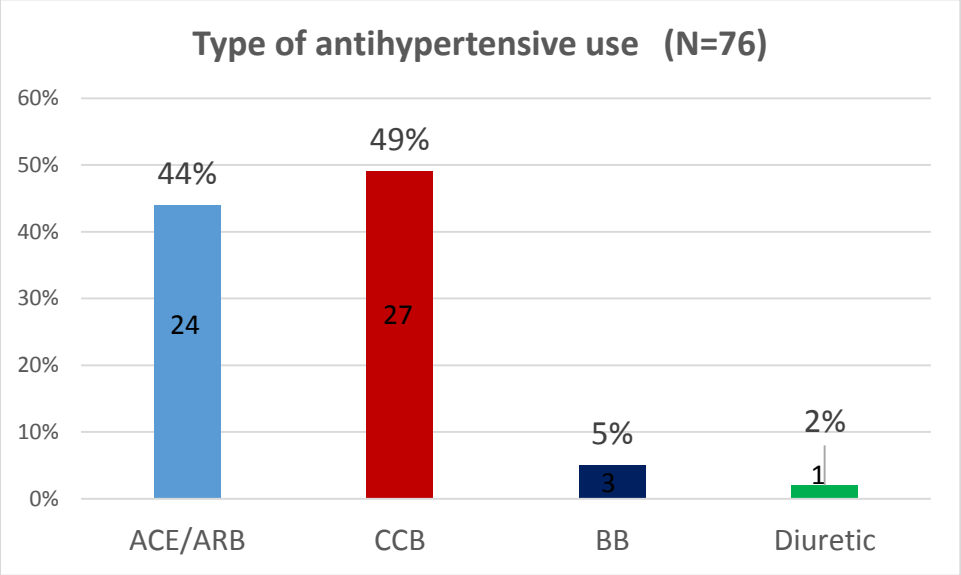


Figure 25: Type of antihypertensive use (N=76)

Based on the baseline characteristics, further analysis was carried out. With the demographic distribution showing a predominance of subjects from Tamil Nadu, West Bengal and Bangladesh, a comparison was done between these groups to look for any differences in the risk factors for hypertension between from South India and North-East India/Bangladesh.

The difference in gender showed more men as compared to women. This could represent an actual difference in hypertension between these two groups or a difference in health seeking behaviour. Hence these two groups – that is men and women were also compared to study any difference in the modifiable risk factors between these two groups.

Primary hypertension is considered a part of the metabolic syndrome, being associated with diabetes, dyslipidaemia and central obesity.

The number of subjects with obesity was found to be 61% (47). Hence a comparison was done between those with and without obesity, to look for other differences in the modifiable risk factors between these two groups.

Epidemiological studies have shown the prevalence of hypertension to be more in urban than rural populations. A note has also been made of the steadily increasing prevalence of hypertension among rural residents.

This study showed a predominance of urban residents with 60% (50) subjects from an urban residence and 40% (26) from a rural one. Thus, a comparison was also made between subjects living in rural and urban residences.

1. Tamil Nadu vs West Bengal/Bangladesh

Sl No	Variable		Tamil Nadu	W.B/Bangladesh	P value
1	Age:	18-30	15% (4)	33% (9)	0.12
		31 - 40	84% (22)	67% (18)	
2	Gender:	Male	65% (17)	66% (18)	0.92
		Female	35% (9)	34% (9)	
3	Age of onset:	18 – 30	31% (8)	63% (17)	0.01
		31 - 40	69% (17)	37% (10)	
4	Family history:	Yes	62% (16)	78% (21)	0.19
		No	38% (10)	22% (6)	
5	Residence:	Urban	71% (22)	43% (12)	0.26
		Rural	29% (9)	57% (16)	
6	Diabetes:	Yes	0% (0)	15% (4)	0.04
		No	100% (26)	85% (23)	
7	Dyslipidaemia:	Yes	31% (8)	56% (15)	0.06
		No	69% (18)	44% (12)	
8	Obesity:	Yes	58% (15)	60% (16)	0.90
		No	42% (11)	40% (11)	
9	Alcohol use:	Yes	19% (5)	4% (1)	0.07
		No	81% (21)	96% (26)	
10	Stress:	High	48% (12)	52% (11)	0.76
		Low	52% (13)	48% (10)	
11	Physical activity: Low-medium		75% (9)	86% (12)	0.51
		High	25% (3)	14% (2)	
12	Diet – Added salt:	Yes	89% (16)	86% (19)	0.52
		No	11% (2)	14% (3)	

Epidemiological studies in India, have shown a geographical difference in the prevalence of hypertension among various states. There has also been a difference in the risk factors.

With the majority of subjects, in this study from Tamil Nadu, West Bengal and Bangladesh, a comparison was done between the subjects from South India and from the eastern part of the country and the adjacent country of Bangladesh.

1. Age:

With regard to the age of the subjects, it was found that in the age group of 18 – 30, the number of subjects from West Bengal / Bangladesh [33% (9)], was twice that of those from Tamil Nadu [15% (4)], with a trend to significance.

There was a statistically significant difference in the age of onset, with the subjects from Tamil Nadu, having an older age of onset [69% (17)] as compared to those from West Bengal / Bangladesh [37% (10)].

2. Gender:

With regards to gender, the distribution of male and female subjects was similar in both groups.

3. Risk factors:

A difference in the risk factors associated with hypertension showed a statistically significant difference between the two groups with respect to diabetes mellitus and trend to significant with respect to dyslipidaemia and alcohol use.

Diabetes mellitus: The prevalence of diabetes mellitus was 15% (4) among those from West Bengal / Bangladesh as compared to 0% from Tamil Nadu.

Dyslipidaemia and obesity: The prevalence of dyslipidaemia in the subjects from West Bengal / Bangladesh was 56% (13) in comparison to those from Tamil Nadu 31% (8). When looking at obesity though the prevalence between both groups was similar, with 58% (15) from Tamil Nadu and 60% (16) being obese.

Stress: The difference in stress both groups was similar with high levels of perceived stress among 48% (12) of those from Tamil Nadu as compared to 52% (11) from West Bengal / Bangladesh.

Physical activity: The majority of subjects from both Tamil Nadu 75% (9) and West Bengal / Bangladesh 86% (12), had low - moderate levels of physical activity, which could be contributing to the hypertension.

Salt intake: The majority of subjects from both Tamil Nadu 89% (16) and from West Bengal / Bangladesh 86% (19), added salt to their daily food intake.

2. Men Vs Women

Sl no	Variable	Men	Women	p value
1	Age : 18 – 30	42% (16)	22% (7)	0.48
	31 – 40	58% (38)	78% (24)	
2	Age of onset: 18 – 30	44% (24)	42% (13)	0.82
	31 – 40	56% (30)	58% (18)	
3	Residence: Urban Rural	73% (38) 27% (15)	54% (17) 45% (14)	0.10
4	Family history: Yes	76% (41)	61% (19)	0.15
	No	24% (13)	39% (12)	
5	Diabetes mellitus: Yes	9% (5)	19% (6)	0.18
	No	91% (49)	81% (25)	
6	Dyslipidaemia: Yes	43% (23)	32% (10)	0.34
	No	57% (31)	68% (21)	
7	Alcohol use: Yes	25% (14)	3% (1)	0.008
	No	75% (40)	97% (30)	
8	Obesity: Yes	66% (30)	35% (11)	0.04
	No	34% (24)	65% (10)	
9	Stress: High	44% (22)	48% (10)	0.78
	Low	56% (28)	52% (11)	
10	Physical activity: Low-Medium	76% (25)	64% (9)	0.47
	High	24% (8)	36% (5)	
11	Diet:			

When men and women were compared, the following was found:

1. Age:

With regard to the age of the subjects and the age of onset of hypertension, there was no statistically significant difference. Both groups were predominantly between the ages of 31 to 40, with 58% (38) men and 78% (24) women in this age group. The age of onset of hypertension, was equally divided between men and women.

2. Risk factors:

With respect to the risk factors of hypertension, there was a difference in the risk factors of residence, family history of hypertension and diabetes mellitus, with a trend to significance. There was a statistically significant difference between the two groups with respect to alcohol use and obesity.

The incidence of obesity among men was 66% (30) as compared to 35% (11) in women and was statistically significant. There was also no statistically significant difference between the two groups with respect to stress levels, physical activity or salt intake.

3. End organ damage – Left ventricular hypertrophy

There was also no statistically significant difference between the two groups with respect to left ventricular hypertrophy.

3. Obese vs Non-obese:

The following is a comparison between the Obese and Non-obese subjects with primary hypertension.

Sl No	Variable		Non-Obese	Obese	P value
1	Age:	18 – 30	48% (14)	15% (7)	0.002
	31 – 40		52% (15)	85% (40)	
2	Gender:	Male	72% (21)	60% (28)	0.25
		Female	28% (8)	40% (19)	
3	Age of onset:	18 – 30	59% (17)	36% (17)	0.05
		31 – 40	41% (12)	64% (30)	
4	Family history:	Yes	66% (19)	72% (34)	0.52
		No	34% (10)	28% (13)	
5	Residence:	Rural	31% (9)	36% (17)	0.64
		Urban	69% (20)	64% (30)	
6	Diabetes:	Yes	7% (2)	13% (6)	0.41
		No	93% (27)	87% (41)	
7	Dyslipidaemia:	Yes	38% (11)	40% (19)	0.82
		No	62% (18)	60% (28)	
8	Alcohol use:	Yes	14% (4)	17% (8)	0.70
		No	86% (25)	83% (39)	
9	Stress:	High	46% (12)	46% (18)	1.0
		Low	54%(14)	54% (21)	
10	Physical activity: Low-medium		80% (12)	70% (19)	0.46
	High:		20% (3)	30% (8)	
11	Added salt:	Yes	90% (18)	91% (32)	0.85
		No	10% (2)	9% (3)	
12	LVH:	Yes	45% (10)	28% (10)	0.16
		No	55% (12)	73% (26)	

These were the observations on comparing subjects with and without obesity:

1. Age:

With regard to the age of the subjects, there was a statistically significant difference between those with and without obesity. Among those with obesity, [85% (40)] were older than 30 years as compared to only [52% (15)] of those without obesity. In those without obesity, the age distribution between those less than 30 [48% (14)] and more than 30 [52% (15)] was roughly the same.

Among those with obesity, a significantly larger number, [64% (30)] developed hypertension before the age of 30, as compared to those without obesity [41% (12)].

2. Gender:

With regards to gender, the distribution of male and female subjects was similar in both groups.

3. Risk factors:

Analysis of the risk factors associated with hypertension did not show a statistical difference between those with and without obesity for a family history of hypertension, diabetes mellitus, dyslipidaemia, residence and alcohol use.

There was also no statistically significant difference between the two groups with respect to stress levels, physical activity or salt intake.

4. End organ damage – Left ventricular hypertrophy

Though left ventricular hypertrophy was seen more among those without obesity [45% (10)], as compared to those with obesity [28% (10)], the difference was not statistically different.

4. Urban vs Rural:

Sl No	Variable		Rural	Urban	P value
1	Age:	18 – 30	27% (7)	28% (14)	0.92
		31 – 40	73% (19)	72% (36)	
2	Gender:	Male	54% (14)	70% (35)	0.16
		Female	46% (12)	30% (15)	
3	Age of onset:	18-30	35% (9)	50% (25)	0.21
		31 – 40	63% (17)	50% 25)	
4	Family history:	Yes	54% (14)	78% (39)	0.03
		No	46% (12)	22% (11)	
5	Diabetes:	Yes	12% (3)	10% (5)	0.83
		No	88% (23)	90% (45)	
6	Dyslipidaemia:	Yes	42% (11)	38% (19)	0.71
		No	58% (15)	62% (31)	
7	Alcohol use:	Yes	7% (2)	20% (10)	0.16
		No	92% (24)	80% (40)	
8	Stress:	High	40% (8)	49% (22)	0.50
		Low	60% (12)	51% (22)	
9	Physical activity: Low-medium		69% (9)	76% (22)	0.83
		High	31% (4)	24% (7)	
10	LVH:	Yes	36% (8)	33% (12)	0.81
		No	64% (14)	67% (24)	

On comparing subjects from Rural and urban residences, the following differences were found.

1. Age:

With regard to the age of the subjects and the age of onset of hypertension, there was no statistically significant difference.

2. Gender:

With regards to gender, the distribution of male and female subjects was similar in both groups.

3. Risk factors:

The only statistically significantly risk factor for hypertension between those from rural and urban residences was a family history of hypertension. Among those from an urban residence, the prevalence of hypertension was 78% (38), as compared to 54% (14) living in a rural area.

There was also no statistically significant difference between the two groups with respect to stress levels, physical activity or salt intake.

4. End organ damage – Left ventricular hypertrophy

There was also no statistically significant difference between the two groups with respect to left ventricular hypertrophy.

DISCUSSION:

The following is the discussion of the results and analysis from this study.

a) Evaluation of secondary hypertension:

The evaluation for a secondary cause for the hypertension was based on a combination of history, physical findings and laboratory tests.

i. History:

This study found that a majority of subjects [60% (51)] were asymptomatic for the hypertension. This is in keeping with hypertension being called the "silent killer" as most patients are usually asymptomatic. Among those who were symptomatic, the commonest symptoms were those of dizziness and headache. A few patients also had symptoms of epistaxis and palpitations. It is also important to note that 5 patients presented with a stroke.

With regards to the history of symptoms suggestive of secondary causes of hypertension, 18% (15) subjects had symptoms. Of these the commonest were symptoms of obstructive sleep apnoea and symptoms of pheochromocytoma.

None of the patients who had symptoms suggestive of obstructive sleep apnoea underwent a sleep study to confirm the presence of obstructive sleep apnoea.

The symptoms of pheochromocytoma are nonspecific and screening by urinary metanephrines and normetanephrines was not suggestive of the same. Studies have shown that this test has a sensitivity of 94% and specificity of 84% (51).

b. Examination:

Examination for signs of secondary hypertension, revealed only two subjects to have signs of secondary hypertension, with one having signs of Cushing's disease and the other signs of hypothyroidism. This is in keeping with other studies where physical examination was found to have a low sensitivity for diagnosing secondary causes of hypertension (15).

c. Laboratory tests:

The evaluation for secondary causes of hypertension in this study was inadequate. This was largely due to the fact that the laboratory evaluation for secondary causes of hypertension was done by the respective treating physician. Thus though 9 subjects were found to have a secondary cause for the hypertension, this number would have been higher if all subjects had undergone a complete evaluation.

Omura et al, in a prospective study among 1020 patients with hypertension carried out a two tiered evaluation for secondary causes of hypertension. The first tier involved testing for the plasma levels of renin, aldosterone, cortisol and catecholamines and an ultrasound of the abdomen. The second tier then consisted of a furosemide plus upright test, captopril renography, dexamethasone suppression test and a 24 hour urinary catecholamine estimation and a CT of the abdomen. With such testing they

were able to detect secondary causes of hypertension in 9.2% (after excluding renal causes). Of these 6% were due to primary aldosteronism (15).

b) Secondary hypertension

Of the 85 subjects included in this study, 9 were found to have a secondary underlying cause for the hypertension. Thus the prevalence of secondary hypertension in this cross sectional descriptive study is 11%. The commonest causes among these being renal and endocrine related. This is in keeping with other studies which have documented similar rates of secondary hypertension. Population studies have shown the prevalence of secondary hypertension to be lower and between 1.1% and 5.7% (52). In children rates of upto 85% have been documented and in adults between 5 to 10% (53).

c) Primary hypertension

In those with Primary hypertension, the majority of subjects [72% (55)] were between the age groups of 31 and 40. Though of the total number, approximately half had an onset of hypertension before 30 years. This is in keeping with existing literature, where the prevalence of hypertension increases with increasing age (16,19).

The gender distribution of hypertension in this study, found that there were more men than women with 64% (49) men and 36% (32) women. This difference could

represent either a true difference in the prevalence of essential hypertension between men and women or a difference in the health seeking behaviour between men and women.

There was a positive family history of hypertension in 70% (53) of the subjects with primary hypertension as compared to 30% (23) who did not. This is in keeping with studies showing a positive family history for hypertension to be a non-modifiable risk factor for hypertension. A Population study from Karnataka, found a positive family history in 41% of individuals with hypertension (54).

With regards to the nature of residence, 66% (50) were from an urban residence and 34% (26) were from a rural residence. This again is in keeping with the prevalence of hypertension being higher in urban areas as compared to rural areas (8).

The prevalence of diabetes mellitus was found to be 11% while that of dyslipidaemia was 39%. The prevalence of obesity was higher at 61%. With regards to obesity, central obesity as measured by waist circumference and waist-hip ratio and the percentage of body fat were also measured. Waist-hip ratio, is a better indicator of central obesity and cardiovascular risk as compared to the body mass index. Also the percentage of body fat is a better indicator of total body fat than the body mass index.

The relationship between body mass index and the percentage of body fat depends of factors such as age, sex and varies in ethnic populations.

Numerous Indian studies have shown diabetes mellitus, dyslipidaemia and obesity to be a risk factors for hypertension (23) (55) (8).

Stress:

Among those with primary hypertension, there was an approximately equal distribution of those with low and high stress levels. Also when comparing between various groups, such as men and women, obese and non-obese, rural and urban and those from Tamil Nadu and West Bengal / Bangladesh, there was no statistically significant difference between groups with regards to stress levels. The stress score used in this study is the Cohen perceived stress scale, which rates the perceived stress over the past month into low and high stress categories. The advantage of this scale is the ease in administration. Some of the difficulties that were encountered were those of language and difficulty with recall, as this rates the stress over the past month. Also most of the answers were subjective. Other existing stress scores like the Holmes and Rahe stress Inventory had a 43 item questionnaire which was too tedious to administer.

As this stress scale rates the perceived stress over the past month, it is not a reflection of the stress levels of the individual at the time of diagnosis of hypertension. It also does not capture the periodic variations in stress levels that one may face.

What can be concluded though is that roughly half the number of subjects had high perceived levels of stress, which needs to be addressed as part of the treatment strategy.

Physical activity:

Of the 42 subjects who underwent a physical activity evaluation, 29% (12) had low levels of activity, 45% (19) had medium levels of activity and 26% 11) had high levels of activity. Thus most subjects had a low to medium level of activity. Studies measuring levels of physical activity in India are sparse. A study among a working adult population in Bangalore, found low levels of physical activity among both men and women (56). A study among residents in the city of Thiruvananthapuram, Kerala, found an inverse relationship between occupations involving moderate or greater physical activity with the prevalence of hypertension (57).

As the subjects, in this study had low to medium levels of physical activity, this is a modifiable risk factor which needs to be addressed. Increasing physical activity should be part of the management of blood pressure control in this population.

Dietary factors:

As per the DASH diet, the two most important dietary modifications for hypertensive patients is a diet that is low in salt and high in potassium (fruit and vegetables). This study found a high prevalence of extra dietary salt being added to food. Indian studies addressing dietary salt intake have documented amounts ranging from 8.5 grams per day to 42.3 grams per day by using methods such as household salt weighing, food

frequency questionnaire and 24 hour urinary sodium excretion. This is variation may be due to the different dietary practices in different regions of the country (45). The DASH diet recommends a dietary salt intake of 2.3 grams of salt per day.

The DASH diet recommends 8 to 10 servings of fruit and vegetables per day, which was not consumed by any of the subjects. The maximum number of servings of fruit and vegetables that were consumed were three per day and this too in 45% of subjects.

End organ damage:

Evidence of end organ damage was assessed by electrocardiographic (ECG) evidence of left ventricular hypertrophy (LVH). One of the drawbacks of the same is that the ECG has a low sensitivity but a high specificity, compared to the echocardiogram which is the gold standard for detecting LVH. Studies from the Framingham Heart Study have shown a sensitivity of 6.9 % and a specificity of 98.8% (58). A study from South India looking at ECG for the diagnosis of left ventricular hypertrophy found the sensitivity to be 43.5% and the specificity to be 88.9%. Thus, though the electrocardiogram is not the ideal screening tool for LVH, it is easily available and cheaper.

Of the 76 subjects with primary hypertension, only 54 underwent an electrocardiogram. The number of subjects with LVH was 20 (37%). This is to say that a little over a third of the subjects had evidence of end organ damage at the time of this study.

Studies from other parts of the country have shown the prevalence of LVH among those with hypertension to vary, with prevalence ranging from 6.5% (Mizoram), 4.4% (Assam), 22.1% (Mumbai) and 21% (Tea garden workers of Assam) (59) (60).

The higher prevalence of LVH in this study could be due to other coexisting factors like obesity and dyslipidaemia which could also be contributing to the same. Increased physical activity is unlikely to be a cause as the assessment for physical activity showed a higher proportion of low to moderate physical activity.

Given the young age of this study population, this brings into sharp focus the need for earlier detection of hypertension and adequate control of the same with simultaneous management of the modifiable risk factors.

Control of blood pressure:

Of the 76 patients with primary hypertension, 21 patients were not on any antihypertensive medications. Of the remaining, the majority were using either a calcium channel blocker or an ACE/ARB for the control of blood pressure. This is in keeping with current recommendations regarding antihypertensive medication use in this population. With regard to the control of blood pressure, it was found that the blood pressure was only well controlled in 40% of subjects. This could be attributed to many factors. Some of the subjects had been incidentally diagnosed just prior to recruitment to the study and had not yet been initiated on antihypertensive therapy. Also this study did not look into the dosing of antihypertensive medications to assess adequacy. A systematic review and meta-analysis of blood pressure control in India, found varying rates of control in different regions of the country. Among rural

populations, the control of blood pressure was 10.7% (6.5-15%) and in urban populations it was 20.2% (11.6-28.7) (61). A cross-sectional survey from Thiruvananthapuram, Kerala, found adequate blood pressure control in 30.6% of antihypertensive patients (57). The PURE study – The Prospective Urban Rural Epidemiology study found the control of blood pressure to be 13% on average between the countries of India, Pakistan and Bangladesh (62).

The difference in rates of blood pressure control between these studies and the current study could be due to the fact that these are epidemiological studies that were community and not clinic based.

Tamil Nadu Vs West Bengal / Bangladesh:

On comparing the differences between those from Tamil Nadu and West Bengal / Bangladesh, the following were found:

With regard to the age of the subjects, it was found that in the age group of 18 – 30, the number of subjects from West Bengal / Bangladesh [33% (9)], was twice that of those from Tamil Nadu [15% (4)], with a trend to significance.

There was a statistically significant difference in the age of onset, with the subjects from Tamil Nadu, having an older age of onset [69% (17)] as compared to those from West Bengal / Bangladesh [37% (10)]. This could represent a difference in the health seeking behaviour between the two regions or a difference due to the referral bias. It could also be due to the actual difference in the age of onset of primary hypertension in both these regions due to genetic factors. This raises the question if genotypic differences could have resulted in this phenotypic difference.

Another reason for this difference could be that of earlier detection in the states of West Bengal / Bangladesh. The health Indices of Tamil Nadu fare better than those of West Bengal / Bangladesh, and given that a majority of subjects were asymptomatic, better surveillance in West Bengal/ Bangladesh seems unlikely. The cause of this difference requires further study.

A difference in the risk factors associated with hypertension showed a statistically significant difference between the two groups with respect to diabetes mellitus and trend to significant with respect to dyslipidaemia and alcohol use.

Diabetes mellitus: The prevalence of diabetes mellitus was 15% (4) among those from West Bengal / Bangladesh as compared to 0% from Tamil Nadu. Though statistically significant, it is difficult to give much weightage to this difference due to the small number.

Dyslipidaemia and obesity: The prevalence of dyslipidaemia in the subjects from West Bengal / Bangladesh was 56% (13) in comparison to those from Tamil Nadu 31% (8). When looking at obesity though the prevalence between both groups was similar, with 58% (15) from Tamil Nadu and 60% (16) being obese.

The reason for the lower prevalence of dyslipidaemia among those from Tamil Nadu could be attributed to genetic factors and dietary habits. The prevalence of dyslipidaemia did not take into account treatment for the same and hence treatment of dyslipidaemia cannot contribute to the difference found between these two groups.

Men vs women:

With respect to the risk factors of hypertension, there was a difference in the risk factors of residence, family history of hypertension and diabetes mellitus, with a trend to significance. There was a statistically significant difference between the two groups with respect to alcohol use and obesity. The difference in alcohol use is not surprising, as alcohol consumption among women in India is low.

The incidence of obesity among men was 66% (30) as compared to 35% (11) in women and was statistically significant. The difference in central obesity though was not statistically significant. This could be attributed to the metabolic syndrome which is associated with hypertension.

Obese Vs Non obese:

With regard to the age of the subjects, there was a statistically significant difference between those with and without obesity. Among those with obesity, [85% (40)] were older than 30 years as compared to only [52% (15)] of those without obesity. In those without obesity, the age distribution between those less than 30 [48% (14)] and more than 30 [52% (15)] was roughly the same.

Among those with obesity, a significantly larger number, [64% (30)] developed hypertension before the age of 30, as compared to those without obesity [41% (12)].

This finding supports the fact that obesity is a risk factor for essential hypertension.

Rural vs urban residence:

On comparing subjects from Rural and urban residences, the following differences were found:

The only statistically significantly risk factor for hypertension between those from rural and urban residences was a family history of hypertension. Among those from an urban residence, the prevalence of hypertension was 78% (38), as compared to 54% (14) living in a rural area. This is similar to a study from Karnataka, comparing the prevalence of hypertension between rural and urban populations between the ages of 20 and 40 in 991 individuals. A family history of hypertension was found more among those from an urban residence as compared to a rural residence. Among those with hypertension, a family history of hypertension was found in 68.8% or urban residents as compared to 20.69% of rural residents (24).

The cause for essential hypertension is a combination of genetic and environmental factors. And thus, people with a genetic predisposition to hypertension, with added environmental factors, in this case urban residence, could go on to develop hypertension.

Conclusion:

1. This study found the prevalence of secondary causes of hypertension in the age group of 18 – 40, in this tertiary care hospital to be 10%.

2. A majority of subjects were incidentally detected to have hypertension.

3. Non- modifiable risk factors that were associated with hypertension were Age, gender, residence and a family history of hypertension.

4. The modifiable risk factors that were associated with hypertension were Obesity, low physical activity and added dietary salt.

5. There was a regional difference between the age of onset between those from Tamil Nadu and West Bengal / Bangladesh.

6. The prevalence of Obesity, as defined by body mass index was higher among men than women though central obesity was high among both men and women.

7. A positive family history of hypertension was higher among those from an urban residence as compared to a rural residence.

8. A majority of subjects had uncontrolled blood pressures.

9. There was a predominance of urban residents in this study with hypertension.

10. Roughly half the subjects had high levels of perceived stress.

11. Most of the subjects had low levels of physical activity.

12. Obesity, which is a risk factor for hypertension, was seen more among the older age group.

Limitations:

1. The estimated sample size was 168, but only 85 was reached. Thus, this may not be fully representative of young hypertensive patients attending the General Medicine OPD at CMCH.

2. The distribution of subjects who had a full evaluation for secondary cause of hypertension, dietary and physical activity evaluation was not complete. Thus some patients with secondary hypertension could have been missed out because they were not fully evaluated.

3. Patients were not routinely evaluated for primary aldosteronism, which in this age group is the leading cause of secondary hypertension.

4. The stress questionnaire that was used was the Cohen perceived stress questionnaire. This assesses perceived stress in the preceding month. Thus, this may not actually be representative of the actual stress.

5. Though there were statistically significant differences between the groups studied, this study was not powered to detect these differences.

Recommendations:

1. An important public health initiative would be screening individuals over the age of 18, for hypertension periodically.

2. This study has also shown that a number of modifiable risk factors are associated with primary hypertension, and hence these should be addressed to achieve better blood pressure control.

3. Dietary modifications as per the DASH diet, increased physical activity and stress relieving techniques should be encouraged in all hypertensive patients.

4. The department of Medicine should formulate a protocol to evaluate all patients below the age of 40 years for secondary causes of hypertension.

5. As Primary aldosteronism is the commonest cause of hypertension in middle-aged adults, patients in this age group with hypertension should routinely be evaluated for the same with a renin: aldosterone ratio and serum potassium used as a screening tool.

6. Hypertensive patients should be screened for obstructive sleep apnoea.

7. Further studies are required to study the differences between the modifiable risk factors among hypertensive individuals less than 40 years old and older.

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Annexures:

PATIENT INFORMATION AND INFORMED CONSENT:

Purpose and subject information and consent form

We are conducting a study on patients presenting with hypertension at a young age and would like to invite you to be a part of this study.

This form describes what this study is about and how it will be carried out. Signing this form will mean that you have agreed to take part. Please read this form carefully and clarify any doubts that you may have regarding the study. Feel free to discuss this with your family or friends. Your participation in this study is a voluntary act and you are free to refuse participation. Your refusal to participate in this study will in no way affect your ongoing medical care and treatment in CMCH.

Purpose of this study

This study is being carried out to study in detail patients presenting with hypertension at a young age. By doing so we will be able to understand the profile of such patients who present to us.

By agreeing to take part, what will you have to do?

On agreeing to participate, 25 minutes of your time will be used to ask a few questions regarding your history and conduct an examination. Your laboratory investigations will be reviewed

Other treatments that you are already on will be continued and your regular treatment will not be changed during this study.

Potential risks and discomforts.

This study does not involve any new drug or treatment. There are no other potential discomforts from this study.

Potential benefits.

By participating in this study you will help us understand the profile of young onset hypertension better. This will then enable us to formulate a more efficient protocol for investigating patients like yourself.

Voluntary participation and withdrawal

Participation in this study is entirely voluntary and you may choose not to participate. Doing so will not affect your medical care in CMCH in any way.

Study related injury

We do not expect any injury to happen to you be participating in this study.

Payment for the study

All your investigations will be done at the cost decided by your treating physician.

Confidentiality

The results of this study will be published in a medical journal but you will not be identified by name in any publication or presentation of results. However, your medical notes will be reviewed by people associated with the study, without your additional permission, should you decide to participate in this study.

Legal rights

You are not waiving any of your legal rights by participating in this study or by signing this consent form, for example, the right to seek damages under law for any research related injury.

CONSENT TO TAKE PART IN THIS CLINICAL TRIAL

Study Title: Profile of patients with young onset hypertension at a Tertiary care hospital in South India.

Study Number:

Participant's name:

Date of Birth / Age (in years):

I_____

_____, son/daughter of _____

1 have read and understood the information sheet provided to me about this and have clarified any doubts that I had.

2. I understand that participation in this study is entirely voluntary. It in not way affects my medical care in CMC nor does it infringe on my legal rights.

3. I understand that there are no financial benefits from participating in this study.

4. By consenting to participate in this study, I understand that the study staff and institutional ethics committee members will not need my permission to look at my health records. I agree to this access.

5. I understand that my identity will not be revealed in any information released to third parties or published.

I voluntarily agree to take part in this study

Name:

Signature:

Date:

Name of witness:

Relation to participant:

Date:

Food frequency questionnaire:

	Food type	≤ once a month	1 -3 /month	1 per week	2 – 4 per week	5 – 6 per week	1 per day	2 – 3 per day	
1	Red meat								
2	Fish								
3	Fruit/Veg(1 serving)								
4	Saturated fat(Butter/ghee)								
5	Alcohol(60 gms)								
6	Fast food								
7	Soft drinks								
8	Sweets								
9	Eating out								

10.Added salt (teaspoon per day):

STOP BANG Questionnaire

Height _____ inches/cm Weight _____ lb/kg
Age _____
Male/Female
BMI _____
Collar size of shirt: S, M, L, XL, or _____ inches/cm
Neck circumference* _____ cm

1. *S*noring
Do you *s*nore loudly (louder than talking or loud enough to be heard through closed doors)?
Yes No

2. *T*ired
Do you often feel *t*ired, fatigued, or sleepy during daytime?
Yes No

3. *O*bserved
Has anyone *o*bserved you stop breathing during your sleep?
Yes No

4. Blood *p*ressure
Do you have or are you being treated for high blood *p*ressure?
Yes No

5. *B*MI
*B*MI more than 35 kg/m^2?
Yes No

6. *A*ge
*A*ge over 50 yr old?
Yes No

7. *N*eck circumference
*N*eck circumference greater than 40 cm?
Yes No

8. *G*ender
*G*ender male?
Yes No

* Neck circumference is measured by staff

High risk of OSA: answering yes to three or more items
Low risk of OSA: answering yes to less than three items

Adapted from:
STOP Questionnaire
A Tool to Screen Patients for Obstructive Sleep Apnea
Frances Chung, F.R.C.P.C., Balaji Yegneswaran, M.B.B.S.,† Pu Liao, M.D.,‡ Sharon A. Chung, Ph.D.,§ Santhira Vairavanathan, M.B.B.S.,_ Sazzadul Islam, M.Sc.,_ Ali Khajehdehi, M.D.,† Colin M. Shapiro, F.R.C.P.C.#*
Anesthesiology 2008; 108:812–21 Copyright © 2008, the American Society of Anesthesiologists, Inc. Lippincott Williams & Wilkins, Inc.

COHEN PERCEIVED STRESS

The following questions ask about your feelings and thoughts during THE PAST MONTH. In each question, you will be asked HOW OFTEN you felt or thought a certain way. Although some of the questions are similar, there are small differences between them and you should treat each one as a separate question. The best approach is to answer fairly quickly. That is, don t try to count up the exact number of times you felt a particular way, but tell me the answer that in general seems the best.

For each statement, please tell me if you have had these thoughts or feelings: never, almost never, sometimes, fairly often, or very often. (Read all answer choices each time)

	Never	Almost Never	Sometimes	Fairly Often	Very Often
B.1. In the past month, how often have you been upset because of something that happened unexpectedly?	0	1	2	3	4
B.2. In the past month, how often have you felt unable to control the important things in your life?	0	1	2	3	4
B.3. In the past month, how often have you felt nervous or stressed?	0	1	2	3	4
B.4. In the past month, how often have you felt confident about your ability to handle personal problems?	0	1	2	3	4
B.5. In the past month, how often have you felt that things were going your way?	0	1	2	3	4
B.6. In the past month, how often have you found that you could not cope with all the things you had to do?	0	1	2	3	4
B.7. In the past month, how often have you been able to control irritations in your life?	0	1	2	3	4

B.8. In the past month, how often have you felt that you were on top of things?	0	1	2	3	4
B.9. In the past month, how often have you been angry because of things that happened that were outside of your control?	0	1	2	3	4
B.10. In the past month, how often have you felt that difficulties were piling up so high that you could not overcome them?	0	1	2	3	4

Perceived Stress Scale Scoring

Each item is rated on a 5-point scale ranging from never (0) to almost always (4). Positively worded items are reverse scored, and the ratings are summed, with higher scores indicating more perceived stress.

PSS-10 scores are obtained by reversing the scores on the four positive items: For example, 0=4, 1=3, 2=2, etc. and then summing across all 10 items. Items 4, 5, 7, and 8 are the positively stated items.

Your Perceived Stress Level was _____

Scores around 13 are considered average. In our own research, we have found that high stress groups usually have a stress score of around 20 points. Scores of 20 or higher are considered high stress, and if you are in this range, you might consider learning new stress reduction techniques as well as increasing your exercise to at least three times a week. High psychological stress is associated with high blood pressure, higher BMI, larger waist to hip ratio, shorter telomere length, higher cortisol levels, suppressed immune function, decreased sleep, and increased alcohol consumption. These are all important risk factors for cardiovascular disease.

id	ho	na	age	sex	state	resid	agos	dura	sysbp	diabp	prese	cns	dm	dl	famht	famd	famdl	famil	famcv	famcl	famot	rx	antiht	other	tobac	typto	pack	alcol	alcwh	typal	amou
1	24976	veena d	38	1	5	1	35	72	999	999	1	1	0	0	0	0	0	0	0	0	0	1	2	0	0			0			
2	25143	hemanta	39	0	28	0	36	72	160	90	5		0	1	0	0	0	0	0	0	0	1	1	0	0			0			
3	23027	suresh	38	0	28	1	38	6	150	95	5		0	0	1	0	0	0	0	0	0	1	4	0	0			0			
4	21718	Subbala	31	1	1	0	31	6	170	999	1	2	1	0	0	0	0	0	0	0	0	1	2	0	0			0			
5	17763	buddhi	36	0	33	1	28	96	140	90	1	1	1	0	1	0	0	0	0	0	0	1	2	0	0			0			
6	16795	sam pau	23	0	11	1	21	24	140	100	5		0	0	1	1	0	0	0	0	0	1	2	0	0			0			
7	82303	babu R	33	0	24	1	32	12	160	110	1	2	0	0	1	0	0	0	0	0	0	1	2	0	0			0			
8	17163	joynul	26	0	33	1	26	0	999	999	5		0	0	0	1	0	0	0	0	0	0		0	0			0			
9	17939	rojeet	27	0	3	1	27	6	140	90	5		0	0	1	0	0	0	0	0	0	0		0	0			1	1	3	180
10	17305	akhanda	27	0	20	1	20	84	140	90	5		0	1	1	1	0	0	0	0	0	1	1	0	0			0			
11	06375	nirmala	19	1	1	0	18	24	160	130	1	3	0	0	0	0	0	0	0	0	0	1	2	0	0			0			
12	49678	suresh	32	0	32	1	32	1	210	140	5		0	0	1	1	0	0	0	0	0	0		0	0			0			
13	14573	amit bar	35	1	5	1	34	12	140	100	5		1	0	1	1	0	0	0	0	0	1	2	0	1	1	1	1	2	3	180
14	11238	shyamal	28	0	28	0	28	1	150	110	1	2	0	0	1	0	0	0	0	0	0	0		0	1	2	2.5	0			
15	12388	joyder p	36	0	28	1	28	96	140	100	1	2	0	0	1	0	0	0	1	0	0	1	2	0	1	1	13.5	1	2		
16	13314	kavitha	38	1	24	1	30	96	999	999	5		0	0	0	1	0	1	0	0	1	1	2	0	0			0			
17	64499	madhu b	37	0	24	1	36	12	999	999	5		0	0	0	0	0	0	0	0	0	0		0	1	1	1.5	1	1	1	60
18	01079	rathna	38	1	24	1	36	8	160	110	5		0	0	0	0	0	0	0	0	0	1	2	0	0			0			
19	33399	rani	32	1	1	0	32	2	140	90	5		0	0	0	0	0	0	0	0	0	0		0	0			0			
20	16723	amita ch	36	1	28	0	36	6	160	130	5		0	0	0	0	0	0	0	0	0	0		1	0			0			
21	16653	sathees	33	0	24	1	33	1	999	999	5		0	0	0	0	0	0	0	0	0	1	2	0	0			0			
22	16411	dinakara	26	0	24	0	24	24	999	999	1	2	0	0	1	1	0	0	0	0	0	1	2	0	0			0			
23	16634	thilagan	37	0	24	0	37	1	150	999	1	2	0	1	0	0	0	0	0	0	0	0		0	0			1	1	3	60
24	84676	soumya	29	1	28	1	27	24	160	100	5		0	0	1	0	1	0	0	0	1	1	2	0	0			0			
25	93918	kavitha	33	1	24	1	28	60	140	110	2		0	0	1	0	0	0	0	0	0	1	2	0	0			0			
26	93233	kalaiche	33	0	24	0	33	1	220	150	5		0	0	1	1	0	0	0	0	0	1	1	0	0			0			
27	14862	nerthika	31	1	24	1	31	0	160	110	5		0	0	1	1	0	0	0	0	1	1	2	0	0			0			
28	89350	sunitha	38	1	24	1	36	24	160	100	5		0	1	1	1	0	1	0	0	0	1	1	1	0			0			
29	14037	khusen	36	1	23	0	35	48	140	90	1	2	0	0	1	0	0	0	0	0	0	0		0	0			0			
30	13790	subimal	39	0	5	1	32	84	140	90	5		1	1	1	0	0	0	0	0	0	1	1	0	0			0			
31	60330	tapasi b	36	1	3	1	32	48	150	110	5		0	0	1	0	0	0	0	0	0	0		0	0			0			
32	93961	rishabh	21	0	26	1	21	1	170	92	5		0	0	1	0	0	0	0	0	0	0		0	1	1	1	1	1	3	60
33	14872	elumalai	37	0	24	1	37	12	140	90	5		0	1	1	1	0	0	0	0	0	1	1	0	0			0			
34	94720	bahadur	35	0	23	0	38	2	170	120	5		0	0	1	0	0	0	0	0	0	1	1	0	1	1	1	1	1	4	60
35	16399	nilonjon	30	0	33	0	28	24	160	130	1	1	0	0	1	0	0	0	0	0	0	1	1	0	0			0			
36	14528	pinki si	32	1	5	1	30	24	140	120	1	2	0	0	1	1	0	0	0	0	0	1	3	0	0			0			
37	74909	velu k	32	0	24	0	30	24	999	999	1	1	1	0	1	1	0	0	0	0	0	1	1	0	0			0			
38	72563	senthil	37	0	24	1	37	1	160	100	5		0	0	1	1	0	0	0	0	0	1	1	0	0			0			
39	20389	aklima	34	1	33	0	31	36	180	90	5		0	0	1	0	0	0	0	0	0	1	2	0	0			0			
40	24138	arnab m	21	0	28	1	18	72	160	90	5		0	0	1	0	0	0	0	0	0	1	1	0	0			0			
41	24301	nilima	24	1	33	1	21	36	999	999	5		0	0	1	0	0	0	0	1	0	0		0	0			0			
42	24678	deepak	40	0	3	1	40	3	210	170	1	1	0	0	1	0	0	0	0	0	0	1	2	0	0			1	2	1	60
43	95940	ganesh	35	0	24	1	33	24	180	120	5		0	0	1	1	1	0	0	0	0	0		0	1	1	7	1	1	3	60
44	24218	zaman	35	0	33	1	28	84	140	90	5		0	0	1	0	0	0	1	0	0	1	1	0	1	1	5	0			
45	23677	mohamr	35	0	33	0	33	24	999	999	5		0	0	1	0	0	0	0	0	0	1	2	0	0			0			
46	15572	mahesh	19	0	24	1	19	2	140	90	5		0	0	1	0	0	0	0	0	0	0		0	0			0			
47	99850	sathish	31	0	24	1	27	48	180	999	1	2	0	0	1	0	0	0	0	0	0	1	1	0	0			0			
48	22315	sanjay	33	0	5	1	32	12	170	90	5		0	0	0	0	0	0	0	0	0	1	1	0	0			1	1	1	60
49	09314	alamelu	37	1	24	0	37	2	190	120	1	2	0	1	1	0	0	0	0	0	0	1	2	0	0			0			

50	21565	kun kun	39	1	28	1	35	48	999	999	5		1	1	1	0	0	1	0	0	0	1	1	0	1	0		0			
51	20755	shahina	38	1	33	0	38	0	999	999	5		1	0	1	1	0	1	0	0	0	0		0	0			0			
52	23982	srinivas	34	0	24	1	34	1	160	100	2		0	0	0	1	0	1	0	0	0	1	2	0	1	1	1	1	1	3	120
53	23118	rupanjita	26	1	25	1	22	48	999	999	1	2	1	0	1	1	0	0	0	0	0	1	1	0	0			0			
54	22776	ashutosl	38	0	4	1	36	24	140	100	5		0	0	1	1	0	1	0	0	0	1	1	0	0			0			
55	23084	biswajith	36	0	28	1	28	96	150	96	5		0	1	1	1	0	0	0	0	0	0		0	0			0			
56	23083	tagari s	30	1	28	0	30	0	150	90	5		0	0	0	0	0	0	0	0	0	0		1	0			0			
57	21701	suji priy	32	1	24	1	30	24	180	120	5		0	0	0	0	0	0	0	0	0	0		0	0			0			
58	50480	rajesh k	39	0	5	1	38	12	140	100	5		0	0	1	0	0	0	0	0	0	1	1	0	0			0			
59	18013	manoj g	35	0	12	1	35	5	160	100	5		0	0	1	1	0	0	0	0	0	1		0	0			1	1	3	60
60	18631	tridip da	38	0	28	1	38	0	160	100	5		0	0	1	0	0	1	0	0	1	0		0	1	1	7	0			
61	18517	supriya	31	1	28	0	30	12	180	100	1	3	0	1	0	0	0	0	0	0	0	1	3	0	0			0			
62	60884	arnab m	30	0	28	1	29	10	160	100	1	1	0	1	1	0	0	1	0	0	0	1	2	0	0			0			
63	94600	chenchu	30	0	1	0	30	2	220	100	5		0	0	0	1	0	1	0	0	0	1	2	0	0			0			
64	92539	faritha	22	1	28	1	22	4	170	90	5		0	0	1	0	0	0	0	0	0	1	1	0	0			0			
65	16614	shantha	35	0	28	1	28	84	240	999	1	3	0	0	1	0	0	0	0	0	0	1	1	0	0			0			
66	81386	rahul ro	37	0	25	1	34	36	999	999	1	1	0	1	0	1	0	0	0	0	0	1	3	0	1	1	4	1	1	3	60
67	93134	gokula k	20	0	24	1	20	4	160	100	1	1	0	0	0	0	0	0	0	0	0	1	2	0	0			0			
68	18656	jayagun	34	1	3	0	31	36	999	999	5		0	0	0	0	0	0	0	0	0	1	1	0	0			0			
69	14516	maniara	40	0	24	0	31	108	140	100	5		0	1	1	0	0	0	0	0	0	1	1	0	0			0			
70	18017	rajkuma	36	0	33	0	34	24	150	100	1	1	0	1	1	1	0	0	0	0	0	1	3	0	0			0			
71	86602	samson	37	0	24	1	37	4	160	100	5		0	1	1	1	1	0	0	0	1	1	2	0	0			0			
72	11023	kumar h	38	0	24	1	38	3	230	999	1	3	0	1	1	0	0	0	0	0	0	1	1	0	0			1	2	3	120
73	40270	sultana	39	1	24	1	37	24	170	100	5		0	0	1	0	0	0	0	0	0	1	2	0	0			0			
74	13016	ifthekha	32	0	33	1	28	48	140	100	1	1	0	1	1	1	0	0	0	0	0	0		0	0			0			
75	13587	Anish J	24	0	4	1	22	24	170	100	1	1	0	0	1	1	1	0	0	0	0	0		0	0			0			
76	13266	sangeet	35	1	24	1	35	0	160	120	5		0	1	1	0	0	0	0	0	0	0		2	0			0			
77	12547	sahana	36	1	4	0	36	1	150	100	5		1	1	0	0	0	0	0	0	0	1	1	2	0			0			
78	13539	sushanta	38	0	28	0	38	0	180	100	5		1	0	1	0	0	0	0	0	0	0		0	0			0			
79	58383	gobinda	25	0	28	1	25	0	158	96	5		0	0	0	0	0	0	0	0	0	0		0	0			0			
80	61377	satish k	36	0	24	1	36	4	180	120	5		0	0	1	1	0	0	0	0	0	1	1	0	0			0			
81	13307	mahabu	37	1	33	0	28	96	999	999	1	1	0	1	1	0	1	1	0	0	0	1	1	0	0			0			
82	18716	kenneth	34	0	24	1	34	6	200	999	5		0	1	1	0	1	0	0	0	0	1	2	0	0			1	1	3	120
83	40345	anjala	28	1	24	0	28	0	200	100	1	3	0	0	1	1	0	1	0	0	0	0		0	0			0			
84	19544	manjula	36	1	24	0	36	6	180	140	1	1	0	0	0	1	0	0	0	0	0	1	2	0	0			0			
85	24598	muthupa	29	0	24	0	27	24	150	90	1	1	0	0	0	1	0	0	0	0	0	1	2	0	1	1	5	0			

freq	rena	cush	phe	hyper	hypot	osa	systbp	diastb	heigh	weight	waist	hip	acar	sighy	sighyp	sigcu	renal	pulses	crea	potass	choles	trigly	hdl	ldl	ac	pc	tsh	cortisol	uricas	urimet
	0	0	0	0	0	0	150	80	150	64	101	94	0	0	0	0	0	0	0.6	4.1	225	178	48	159			5.7		0	487
	0	0	0	0	0	0			166	67	89	93	0	0	0	0	0	0	0.9	3.5	138	142	26	93	136	140	0.1	19.1	0	
	0	0	0	0	0	0			165	67	94	95	0	0	0	0	0	0	0.8		159	361	31	81	127	129	3.9		0	153
	0	0	0	0	0	0							0	0	0	0	0	0	0.7	4.3	191	160	37	130	115	184	99.9		0	
	0	0	0	0	0	0	999	999	175	72	91	98	0	0	0	0	0	0	1	4.1	185	373	25	101	134	221	1.3	16.3	0	
	0	0	0	0	0	0	999	999	172	58	73	93	0	0	0	0	0	0	0.9	4.2				148	91		2.1	13.1	0	
	0	0	0	0	0	0	160	100	161	57	83	93	0	0	0	0	0	0	0.8								1.4	15.6	0	170
	0	0	0	0	0	0	999	999	162	77	91	100	1	0	0	0	0	0	0.8	4.6	218	474	33	137	101	125	1.7		0	
3	0	0	0	0	0	0	999	999	175	70	86	101	0	0	0	0	0	0	1	4.4	166	79	46	102	89	93	1.3	21.8	0	224
	0	0	0	0	0	0							0	0	0	0	0	0	0.8	4.1	105	160	40	80	89	122	0.9	23.1	0	100
	0	0	0	0	0	0	999	999	160	48	71	88	0	0	0	0	0	0	0.9	4.1									0	124
	0	0	0	0	0	1	999	999	165	87	100	109	0	0	0	0	0	0	0.9		169	104	36	113	90	82	4.8	13	1	517
4	0	0	0	0	0	0	999	999	999	999	999	999	0	0	0	0	0	0	0.7	4.7				93			1	22	0	272
	0	0	0	0	0	0	150	110	163	46	70	82	0	0	0	0	0	0	0.8	3.5	201	104	37	145			2.8		0	180
	0	0	0	0	0	0	999	999	999	999	999	999	0	0	0	0	0	0	0.9		201	196	31	144	88	124	1.9		0	253
	0	0	0	0	0	0	999	999	999	70	97	107	0	0	0	0	0	0										6.4	0	226
3	0	0	0	0	0	0	130	80	999	92	102	108	0	0	0	0	0	0	0.9	4.3	166	174	32	110	94	70			0	446
	0	0	0	0	0	0	999	999	154	65	88	106	1	0	0	0	0	0	0.7	4.1	136	101	45	80	96	130	0.9	11.2	0	
	0	0	0	0	0	0	999	999	167	74	98	96	0	0	0	0	0	0	0.8	3.8					90		2.1	9.3	0	
	0	0	0	0	0	0	999	999	162	60	999	999	0	0	0	0	0	0											0	
	0	0	0	0	0	0	999	999	168	69	88	97	0	0	0	0	0	0	0.9	3.9							2.9		0	460
	0	0	0	0	0	0	999	999	184	83	90	98	0	0	0	0	0	0	0.9	4.2	154	98	37	104	88	83	1.5		0	220
2	0	0	0	0	0	0	999	999	161	68	96	96	0	0	0	0	0	0	0.7	3.7				127	97	167			0	
	0	0	0	0	0	1	120	80	184	96	94	107	0	0	0	0	0	0	0.9	3.7	188	104	34	134	92	91	2.2	22.7	0	389
	0	0	0	0	0	0	999	999	159	999	77	117	0	0	0	0	0	0	0.5	4	139	72	45	91	86	80	1.9	14.6	0	390
	0	0	0	0	0	0	150	100	176	66	78	94	0	0	0	0	0	0	1	3.3	167	75	48	102	110	124	5.5		0	452
	0	0	0	0	0	0	180	120	152	61	93	100	0	0	0	0	0	0											0	
	0	0	1	0	0	0	999	999	157	54	73	98	0	0	0	0	0	0	0.6	3.9	205	90	34	145	85	119	1.4	16.7	0	209
	0	0	0	0	0	0	142	90	999	64	88	98	0	0	0	0	0	0	0.5	3.9	172	123	44	112	90	102	1.6	6.7	0	346
	0	0	0	0	0	0	160	100	176	73	93	98	0	0	0	0	0	0	0.9	4.2	104	124	45	80	167	214	2.5		0	
	0	0	0	0	0	0	156	88	165	61	82	99	0	0	0	0	0	0	0.7	4									0	
4	0	0	0	0	0	0	999	999	177	63	79	82	0	0	0	0	0	0	0.8	3.6									0	
	0	0	0	0	0	0	999	999	173	81	999	999	0	0	0	0	0	0	0.9		243	114	51	173	91	95	0.9	7.3	0	494
2	0	0	0	0	0	0	999	999	172	74	92	100	0	0	0	0	0	0	0.8	3.9	177	151	37	117	92	77	1.6	13.2	0	204
	0	0	0	0	0	0	999	999	172	57	84	91	0	0	0	0	0	0	0.7		117	250	41	80	98	99	1.1		0	247
	0	0	0	0	0	0	999	999	158	71	86	105	0	0	0	0	0	0	0.7	3.9		77		81	91				0	
	0	0	0	0	0	1	999	999	154	84	106	109	1	0	0	0	0	0	0.9	4.8				109	122	227	2.1	9.7	0	
	0	0	0	0	0	0	999	999	999	999	120	124	1	0	0	0	0	0	1		181	176	31	122	123	230	1.1		0	
	0	0	0	0	0	0	999	999	155	71	98	107	0	0	0	0	0	0	0.7		172	96	42	123	98	87	1.1		0	306
	0	0	0	0	0	0	999	999	177	78	91	101	0	0	0	0	0	0	0.7		100	83	30	80			1.9		0	175
	0	0	0	0	0	0	999	999	160	46	63	85	0	0	0	0	0	0	6	4									0	
1	0	0	0	0	0	0	999	999	170	52	68	85	0	0	0	0	0	0	8.2	4.3	134	93	62	80			10.1	18.1	0	320
1	0	0	0	0	0	0	999	999	175	65	78	93	0	0	0	0	0	0	3.7	3.7	189	138	45	125	92	95	1.9	20.1	0	323
	0	0	0	0	0	0	999	999	170	87	101	111	0	0	0	0	0	0	1	3.7	165	77	41	111	93	78	1.5		0	193
	0	0	0	0	0	0	999	999	173	75	96	105	1	0	0	0	0	0	0.9	3.8							1.6	16.3	0	
	0	0	0	0	0	0	999	999	183	52	85	102	0	0	0	0	0	0	0.6	4.4	123	45	40	80			1.7	15.6	0	235
	0	0	0	0	0	0	999	999	180	82	96	105	0	0	0	0	0	0	0.8						101	93			0	
3	0	0	0	0	0	0	999	999	164	54	84	89	0	0	0	0	0	0	0.6	3.9							2.5	9.4	0	236
	0	0	0	0	0	0	999	999	147	62	103	100	0	0	0	0	0	0	0.6	4.9	239	151	50	158	79	74	4.9	10.6	0	499

	0	0	0	0	0	0	999	999	150	70	109	101	0	0	0	0	0	0	0.7	3.7	182	114	40	110	130	221	1.9		0	
	0	0	0	0	0	0	999	999	164	87	117	112	1	0	0	0	0	0	0.5		196	183	32	133	132	192	4.4		0	258
2	0	0	1	0	0	0	999	999	172	81	97	99	0	0	0	0	0	0											0	
	0	0	0	0	0	0	999	999	140	52	83	93	0	0	0	0	0	0	0.5	4.1	132	258	37	80	126	190	2.5		0	194
	0	0	0	0	0	1	999	999	172	87	104	104	1	0	0	0	0	0	0.7		113	252	27	80	94	112	3.7		0	443
	0	0	0	0	0	0	999	999	172	80	94	102	0	0	0	0	0	0	0.8		232	368	39	155	100	99			0	531
	0	0	0	0	0	0	999	999	145	55	90	99	0	0	0	0	0	0	0.5										0	
	0	0	0	0	0	0	999	999	152	52	77	95	0	0	0	0	0	0	0.6	4.1	170	149	34	112	91	111	2.5		0	100
	0	0	0	0	0	0	999	999	172	86	110	102	0	0	0	0	0	0	0.7	4	163	131	31	108	88	99	7.7	23.6	0	361
2	0	0	0	0	0	1	999	999	179	108	116	115	0	0	0	0	0	0	0.7	3.5	178	173	35	113			1.1	10.7	0	207
	0	0	0	0	0	1	999	999	165	93	110	116	1	0	0	0	0	0			206	91	47	142	93	105	2.9		0	339
	0	0	0	0	0	0	999	999	150	46	82	86	0	0	0	0	0	0	0.6	4	132	77	56	80	107	93	2.5	12.5	0	116
	0	0	1	0	0	0	999	999	178	999	88	100	0	0	0	0	0	0	0.9		107	70	36	80	90	79			0	
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	0	0	0	0	1	0	999	999	147	46	84	85	0	0	0	0	0	0	0.5	3.4							39.1		0	457
	0	0	0	0	0	0	999	999	172	81	109	101	1	0	0	0	0	0	1.3	3.3	123	84	29	80	85				0	
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	0	0	0	0	0	0	999	999	175	71			0	0	0	0	0	0	0.8	4.1	119	57	51	80	90	90	1.6	26.6	0	172
	0	0	0	0	0	0	999	999	161	67	103	97	0	0	0	0	0	0	0.7	4.1	206	115	36	142	118	135	2.6		0	
	0	0	0	0	0	0	999	999	161	75	101	98	0	0	0	0	0	0	0.9	4.3	196	149	30	137	84	131	2.3		0	
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	0	0	0	0	0	0	999	999	182	106	109	124	1	0	0	0	0	0	0.9	4.3	178	87	39	120	97	82	2.2		0	556
2	0	0	0	0	0	0	999	999	166	69	87	98	0	0	0	0	0	0	0.8	3.9	232	189	53	162	79	75	1.2		0	424
	0	0	0	0	0	0	999	999	150	51	78	97	0	0	0	0	0	0	0.7	3.9	205	156	40	142	97	121	1.5		0	
	0	0	1	0	0	1	130	96	182	117	123	119	1	0	0	0	0	0	0.8	4.1	186	217	28	129	104	109	4	19.3	0	266
	0	0	1	0	0	0	999	999	171	82	104	108	0	0	0	0	0	0	0.6	4.2	172	138	40	113	94	82	1.5		0	484
	0	0	0	0	0	1	999	999	155	132	141	147	1	0	0	0	0	0	0.8		253	211	64	170	128	133	0.7	0.5	0	
	0	0	0	0	0	0	999	999	150	73	108	140	1	0	0	1	0	0	0.5	3.8	196	413	30	115	141	263	3.8	10.9	0	
	0	0	1	0	0	0	999	999	164	68	90	100	0	0	0	0	0	0	0.7		130	120	34	84	147	279	1.4	17.4	0	427
	0	0	0	0	0	0	999	999	162	60	999	999	0	0	0	0	0	0	0.7	4	173	175	32	117	97		0.5		0	544
	0	0	0	0	0	0	999	999	181	85	999	999	0	0	0	0	0	0	0.7	4.5	184	52	82	86			2.6		0	
	0	0	0	0	0	0	110	80	153	65	94	106	0	0	0	0	0	0	0.7	4.1	198	236	37	135	98	129	2.4	12.6	0	
2	0	0	0	0	0	0	999	999	999	999	91	102	0	0	0	0	0	0	0.7		184	175	42	120	86	134			0	
	0	0	0	0	0	0	130	80	152	51	73	91	0	0	0	0	0	0	0.8	2.9	213	121	74	125	91	93			0	418
	0	0	0	0	0	0	999	999	160	999	93	101	0	0	0	0	0	0	0.6	4.1					94	110	3.5		0	111
	0	0	0	0	0	0	999	999	172	72	97	100	0	0	0	0	0	0	0.8	4.7	143	163	24	96	92	154	5.8	18.8	0	329

ecg	renal	dech	cs	ecc	mets	stress	red	fish	fruit	fat	fast	soft	sw	eat	sav	add	lbm	slm	bf	pbf	vfa	hba	ace	ccb	bb	di
0	0	0	0			14	1	2	1	1	1	1	3	7	7	1	40	37	24	37	107	5.7	0	0	0	0
1	0	0	0			31	1	5	5	1	1	1	4	6	4	1	48	45	18.5	27	128		0	0	0	0
0	0	0	0			99	1	6	6	4	4	2	1	1	1	1	51	47	16.9	25	107		0	0	0	0
0	0	0	0				1	1	6	1	1	7	1	1	7	1	45	41	27.2	37	108		0	0	0	0
1	0	0	0			12	1	4	7	2	4	2	3	1	5	1	55	51	16.8	23	99	7.7	0	0	0	0
1	0	0	0		565	4	1	5	6	1	3	1	3	1	4	1	51	48	10	13	50		0	0	0	0
0	0	0	0		5079	32	1	4	6	1	4	2	2	1	3	0	46	43	10.5	19	65		0	0	0	0
0	0	0	0		396	24	1	4	7	2	4	1	2	1	5	1	53	58	24.4	31	124		0	0	0	0
0	0	0	0		3864	13	1	4	6	2	4	2	4	1	5	1	54	50	15	22	72		0	0	0	0
0	0	0	0		532	32	1	5	7	2	4	2	3	1	4	1	25	54	19.5	25	80		0	0	0	0
0	0	0	0													0	37	34	11	23	50		0	0	0	0
0	0	0	0			30										0	58	53	29	33	147	5.5	0	0	0	0
0	0	0	0													0						7.3	0	0	0	0
1	0	0	0													0							0	0	0	0
1	0	0	0													0							0	0	0	0
0	0	0	0		3198	22	2	4	7	3	1	2	4	1	2	1	44	40	28.5	40	125		0	0	0	0
0	0	0	0		4095	21	2	2	7	4	4	2	3	1	3	1	65	59	24.2	27	123		0	0	0	0
0	0	0	0													0							0	0	0	0
0	0	0	0			17										0							0	0	0	0
0	0	0	0			18										0	42	39	17	28	50		0	0	0	0
1	0	0	0			16	3	4	7	3	3	2	2	1	4	1	52	48	17.9	25	85		0	0	0	0
0	0	0	0			35										0	68	63	14	17	58		0	0	0	0
0	0	0	0			12										0	48	44	20.2	30	142		0	0	0	0
0	0	0	0		1522	10	2	5	6	3	6	3	6	6	5	1	76	70	20.4	21	70		0	0	0	0
0	0	0	0			25	2	4	5	2	4	1	1	3	4	1	42	38	23.9	36	99		0	0	0	0
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0	0	0	0			8	1	3	7	2	1	3	3	1	4	1	39	36	22.6	36	100		0	0	0	0
0	0	0	0			22										0	40	37	13.7	25	50		0	0	0	0
0	0	0	0			13										0							0	0	0	0
0	0	0	0		1194	16	2	5	3	4	2	3	4	1	6	1	58	53	16	22	96	8.5	0	0	0	0
0	0	0	0		456	20	1	5	3	5	7	2	3	1	6	1	44	40	17.7	29	50		0	0	0	0
0	0	0	0		1848	21										0	53	49	10	15	51		0	0	0	0
0	0	0	0		891	8	1	4	6	2	4	2	3	1	4	1	56	52	24.7	30	151		0	0	0	0
1	0	0	0		504	17	1	2	7	2	4	2	4	1	5	1	55	51	18	25	110		0	0	0	0
1	0	0	0		462	20	1	5	6	2	3	1	2	1	4	1	48	45	10	15	52		0	0	0	0
0	0	0	0			13										0	47	43	23	32	72		0	0	0	0
1	0	0	0			12	1	1	6	1	2	2	3	1	4	1	52	48	31	37	191		0	0	0	0
0	0	0	0		1807	16										0							0	0	0	0
0	0	0	0			99										0	45	41	26	37	104		0	0	0	0
0	0	0	0		553	26	1	3	5	6	7	4	7	5	1	1	59	55	18.9	24	73		0	0	0	0
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1	0	1	1		2289	15	2	4	7	3	4	1	3	1	4	1	44	41	10	18	64		0	0	0	0
0	0	0	0		1278	15	1	4	5	4	5	2	4	1	5	1	38	35	23.8	38	113		0	0	0	0

1	0	0	0	2022	25	1	5	7	3	3	1	2	1	4	1	43	39	27.4	38	123	7.9	0	0	0	0
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0	0	0	0	4980	21										0	74	68	33.6	31	155		0	0	0	0
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0	0	0	0		11										0	63	58	22	26	113		0	0	0	0
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0	0	0	0		11										0							0	0	0	0
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0	0	0	0	1738	32	3	3	6	3	7	1	1	1	7	1	45	41	24.5	35	93		0	0	0	0
1	0	0	0		26										0	57	53	17.5	23	75		0	0	0	0